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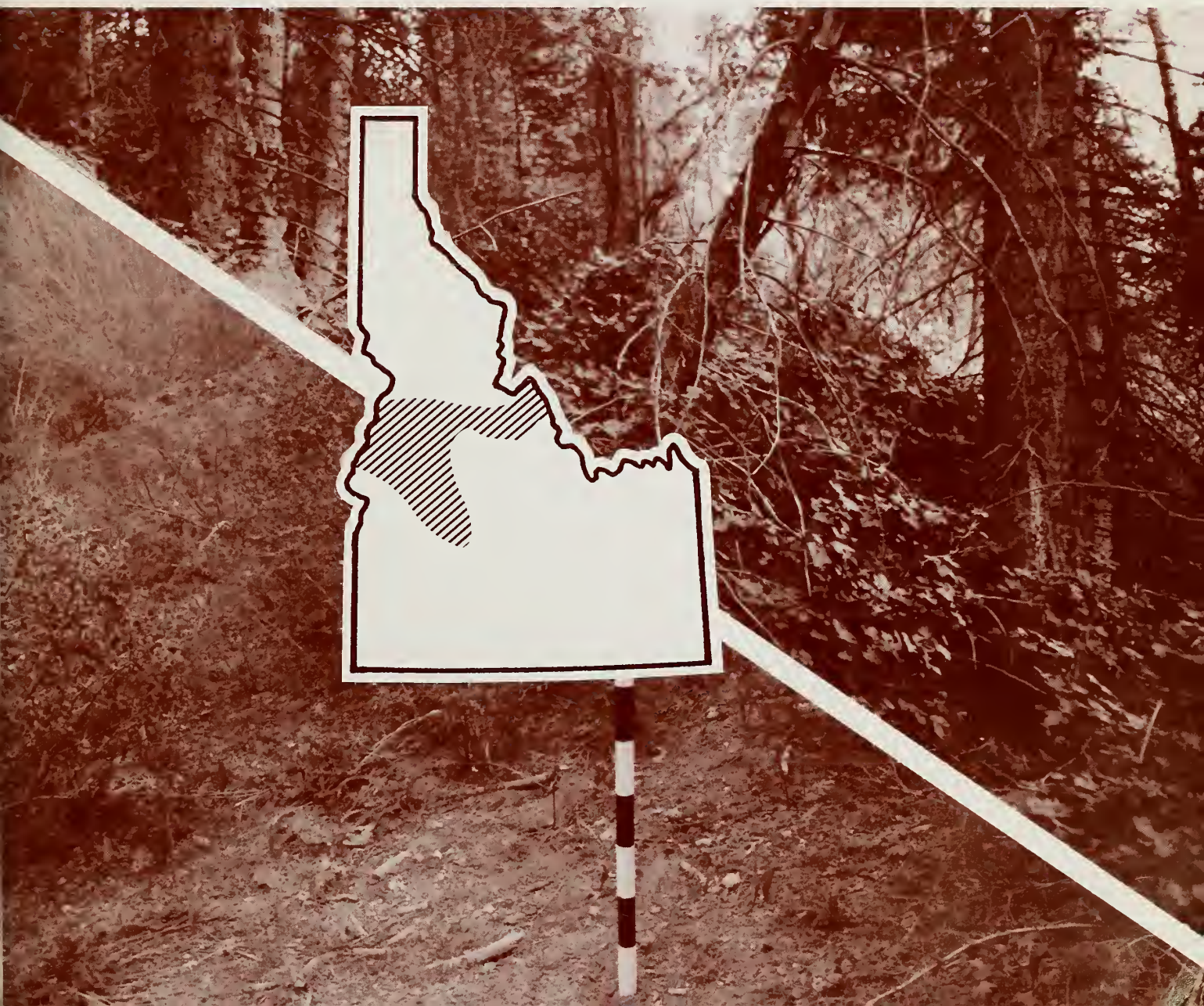
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The Douglas-fir/ Ninebark Habitat Type in Central Idaho: Succession and Management

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RESEARCH SUMMARY

A succession classification system for the Douglas-fir/ninebark habitat type is presented. It is based on reconnaissance sampling of 152 stands: 27 old-growth sites, 31 pairs of old-growth versus disturbance sites, and 63 additional disturbed sites. A total of six potential tree layer types, 28 shrub layer types, and 55 herbaceous layer types are categorized by a hierarchical taxonomic classification. Diagnostic keys based on indicator species are provided for field identification of the layer types.

Implications for natural resource management are provided based on field data and observations. These implications include: occurrence of pocket gophers and success of tree plantations by site preparation treatments, initial growth rates of tree seedlings and yield capability of mature trees, microsite needs of natural tree seedlings, big-game and livestock forage preferences of shrub and herb layer types, and responses of major shrub and herb layer species to various disturbances. Species composition data for each of the tree, shrub, and herb layer types that were sampled are displayed in tables.

CONTENTS

	Page
Introduction	1
Objectives	2
Methods	2
The PSME/PHMA Habitat Type	2
Distribution	2
Description (PIPO Phase Only)	4
Early Seral	4
Mid-seral	5
Climax	5
Successional Features	5
Succession Classification	5
The Tree Layer	5
Size Class Notations	7
<i>Populus tremuloides</i> Layer Group (POTR L.G.)	8
<i>Pinus ponderosa</i> Layer Group (PIPO L.G.)	8
<i>Pseudotsuga menziesii</i> Layer Group (PSME L.G.)	10
Management Implications	10
The Shrub Layer	14
<i>Ceanothus velutinus</i> Layer Group (CEVE L.G.)	18
<i>Ribes cereum</i> Layer Group (RICE L.G.)	19
<i>Salix scouleriana</i> Layer Group (SASC L.G.)	19
<i>Prunus emarginata</i> Layer Group (PREM L.G.)	19
<i>Amelanchier alnifolia</i> Layer Group (AMAL L.G.)	20
<i>Spiraea betulifolia</i> Layer Group (SPBE L.G.)	20
<i>Physocarpus malvaceus</i> Layer Group (PHMA L.G.)	20
Management Implications	21
The Herb Layer	30
Annals Layer Group (ANN. L.G.)	36
<i>Bromus carinatus</i> Layer Group (BRCA L.G.)	36
<i>Potentilla glandulosa</i> Layer Group (POGL L.G.)	36
<i>Iliamna rivularis</i> Layer Group (ILRI L.G.)	37
<i>Epilobium angustifolium</i> Layer Group (EPAN L.G.)	38
<i>Apocynum androsaemifolium</i> (APAN L.G.)	38
<i>Fragaria vesca</i> Layer Group (FRVE L.G.)	39
<i>Carex geyeri</i> Layer Group (CAGE L.G.)	39
<i>Calamagrostis rubescens</i> Layer Group (CARU L.G.)	39
<i>Thalictrum occidentale</i> Layer Group (THOC L.G.)	40
Management Implications	40
References	43
Appendixes:	
A. Constancy and Average Canopy Cover (Percent) of Trees by Layer Type in the PSME/PHMA H.T., PIPO Phase, Showing Size Class Distribution and Average Basal Area	47
B-1. Palatability Ratings, Constancy, and Average Canopy Cover (Percent) of Shrubs by Layer Type in the PSME/PHMA H.T., PIPO Phase	51
B-2. Successional Direction of Shrub Layer Types in the CEVE Layer Group as Inferred From Individual Plot Data	55
B-3. Successional Direction of Shrub Layer Types in the RICE Layer Group as Inferred From Individual Plot Data	56

Page

B-4. Successional Direction of Shrub Layer Types in the SASC Layer Group as Inferred From Individual Plot Data	57
B-5. Successional Direction of Shrub Layer Types in the PREM Layer Group as Inferred From Individual Plot Data	58
B-6. Successional Direction of Shrub Layer Types in the AMAL Layer Group as Inferred From Individual Plot Data	59
B-7. Successional Direction of Shrub Layer Types in the SPBE Layer Group as Inferred From Individual Plot Data	60
C. Palatability Ratings, Constancy, and Average Canopy Cover (Percent) of Herb Layer Species by Layer Type in the PSME/PHMA H.T., PIPO Phase	61
D. Succession Classification Field Form for the Douglas-fir/Ninebark H.T.	65

TABLES

1. Phase designations of the PSME/PHMA h.t. suggested by various studies	3
2. Occurrence of tree species in phases of the PSME/PHMA h.t.	3
3. Key to tree layer groups and layer types, with ADP codes, in the PSME/PHMA h.t.	8
4. Occurrence of pocket gopher mounds following various site disturbances in the PSME/PHMA h.t., PIPO phase	11
5. Success of tree plantations by site treatment in the PSME/PHMA h.t., PIPO phase	12
6. Growth and yield characteristics of trees in the PSME/PHMA h.t., PIPO phase	14
7. Occurrence and roles of shrub species in the PSME/PHMA h.t. in central Idaho	14
8. Key to shrub layer groups and layer types, with ADP codes, in the PSME/PHMA h.t., PIPO phase	17
9. Relative index classes to big-game and livestock forage preferences by shrub layer types in the PSME/PHMA h.t., PIPO phase	22
10. Responses of major shrub species to various disturbances in the PSME/PHMA h.t., PIPO phase	24
11. Occurrence of natural tree seedlings (percent) by silvicultural method and overstory composition for the PSME/PHMA h.t., PIPO phase	28
12. Occurrence of natural tree seedlings (percent) by site preparation method for the PSME/PHMA h.t., PIPO phase	28
13. Occurrence of natural tree seedlings (percent) by seedbed with regeneration efficiencies (RE) of seedbeds for the PSME/PHMA h.t., PIPO phase	29
14. Occurrence of natural tree seedlings (percent) by shrub canopy cover for the PSME/PHMA h.t., PIPO phase	29

	Page
15. Regeneration efficiency (RE) values of shrub canopies and other microsites for tree seedlings in the PSME/PHMA h.t., PIPO phase	29
16. Occurrence of natural tree seedlings (percent) by tree and shrub layer groups in the PSME/PHMA h.t., PIPO phase	30
17. Successional roles of major herb layer species in the PSME/PHMA h.t., PIPO phase	31
18. Key to herb layer groups and layer types, with ADP codes, in the PSME/PHMA h.t., PIPO phase	34
19. Relative index classes of big-game and livestock forage preferences by herb layer types in the PSME/PHMA h.t., PIPO phase	41

FIGURES

1. Distribution of the PSME/PHMA h.t. in central Idaho, PIPO phase (•) and PSME phase (x)	4
2. Relative successional amplitudes of major tree species in the PSME/PHMA h.t., PIPO phase	6
3. Succession classification diagram of the tree layer in the PSME/PHMA h.t., PIPO phase	6
4. A pole POTR-pole POTR tree layer type west of Idaho City, ID, in 1985	9
5. A pole PIPO-mature PIPO tree layer type in the Andersen Creek drainage east of Crouch, ID, in 1979	9
6. A pole PSME-mature PSME tree layer type southwest of Idaho City, ID, in 1979	10
7. An old plantation of <i>Pinus ponderosa</i> on contour terraces	12
8. Relative successional amplitudes of important shrub species in the PSME/PHMA h.t., PIPO phase	15

	Page
9. Succession classification diagram of the shrub layer in the PSME/PHMA h.t., PIPO phase	16
10. A CEVE-AMAL shrub layer type in the Bannock Creek drainage southeast of Idaho City, ID	18
11. A PHMA-PHMA shrub layer type in Logging Gulch southeast of Idaho City, ID	21
12. Height-age relationships of planted free-growing tree seedlings and important free-growing shrub species in the PSME/PHMA h.t., PIPO phase	25
13a. A site that was clearcut and broadcast burned 4 years ago in 1975	26
13b. Same site as above in 1986, 11 years after broadcast burning	26
14. Relative successional amplitudes of important herb layer species in the PSME/PHMA h.t., PIPO phase	32
15. Succession classification diagram of the herbaceous layer in the PSME/PHMA h.t., PIPO phase	33
16. A BRCA-BRCA herb layer type east of Lowman, ID	36
17. An ILRI-ILRI herb layer type north of Bogus Basin Ski Area	37
18. An EPAN-EPAN herb layer type northeast of New Centerville, ID	38
19. A POGL-POGL herb layer type supporting a high level of pocket gopher activity	42
20. Constancy and average number per acre of pocket gopher mounds in various herb layer types	43

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INTRODUCTION

Over much of the Western United States, development of habitat type classifications based on potential natural vegetation (Pfister 1984) has increased professional awareness of vegetation and its variability. Those who manage natural resources now recognize the need to foresee the changes in vegetation that may result from management activities. But to understand and communicate these changes, one's perspective must encompass the often bewildering integration of cause and effect, and random, cyclic, and temporal relationships that are manifest in succession dynamics. Logically, the first step is to classify seral vegetation into a manageable number of recognizable units.

Habitat type classifications focus on the environmental (site) differences affecting vegetation. They provide a logical framework for studying succession and occasionally infer successional relationships but offer no classification of seral communities. As one approach to meeting this need, we present herein a classification of seral vegetation designed for general field use. In so doing, we have attempted to exploit the fact that natural classifications, in contrast to technical ones designed for a specific use, have broader application and often provide greater prediction capability. The widely accepted habitat type system of classification is an outstanding example of a natural classification, and as its originators, R. and J. Daubenmire (1968), have pointed out "... that system may be considered the closest to a natural one that allows the most predictions about a unit from a mere knowledge of its position in the system." We developed the following classification with these criteria in mind so that the relative position of a classified unit in the system can help predict the successional direction of that unit. In doing this, we found that some types of seral vegetation are strongly related to a specific disturbance; other types develop mainly through uninterrupted succession. These cause and effect relationships are presented in various ways in the sections dealing with classification as well as those dealing with management implications.

Throughout this text the reader must remember that vegetation is influenced by two independent variables: time and environment. Environment, as it affects vegetation, can be delineated by habitat types or potential climax communities (Daubenmire 1952) that are relatively stable barring disturbance. In a similar manner,

time, as it relates to succession, can be delineated by community types or seral stages that can be obliterated, slightly altered, or even advanced through various disturbances. Habitat type classifications have proven useful in much of the West (Layser 1974) and by focusing on climax potential enable investigators to hold time constant while grouping plant communities that have similar environments. Conversely, environment can be held relatively constant by using habitat types while focusing on seral vegetation.

This report presents the seral vegetation and related resource values occurring over time in one forest environment, the *Pseudotsuga menziesii*/*Physocarpus malvaceus* habitat type (PSME/PHMA h.t.) (Steele and others 1981). The classification approach used here accommodates the individual nature of specific sites in terms of existing and potential species composition. It also accommodates the land manager's need for site-specific guidelines for intensive management purposes. In this regard, management implications for many species can be derived from each species' reaction to a particular disturbance and its successional strategy. This report can be applied to specific sites by understanding the successional characteristics presented for each major species and then synthesizing that knowledge for the existing and potential species on a particular site. Sometimes, the preliminary nature and meager data base herein require tentative use as a management guide. Throughout this report, users should focus on the relative nature of data presented rather than absolute values. Because this report was developed through a series of approximations, it should always be open to further refinement. We welcome suggestions and comments.

This report uses a classification system (Steele 1984) that recognizes the somewhat independent nature of succession between the tree, shrub, and herbaceous layers (often due to layer-specific disturbances such as selective tree harvesting or grazing) and treats these three successions separately. It recognizes the high potential diversity of early and mid-seral vegetation and the relative forage values to livestock and big game. It also indicates some interrelationships of site treatment, planted and natural tree survival, competing vegetation, and pocket gopher populations. Most important, it provides a common framework for communication among various resource disciplines.

Objectives

The objectives of this report are:

1. To develop a classification of seral vegetation in the PSME/PHMA h.t. based on indicator species and vegetal structure.
2. To identify successional relationships of seral vegetation and the kinds of disturbances that generate this vegetation.
3. To present species composition and canopy coverage information for each shrub and herbaceous layer and the relative value of these layers as forage for big game and livestock.
4. To describe suitable conditions for natural and artificial establishment of tree seedlings and early growth characteristics of trees in relation to site treatment, microsite conditions, and competing vegetation.
5. To determine the number of years required for each tree species to reach breast height (4.5 feet, 1.4 m) in the PSME/PHMA h.t.
6. To provide a basis for developing preliminary management implications by seral community type.

Methods

This report is the second of a series on succession and management in forest habitat types. The methods used herein are identical to those of the previous report covering the grand-fir/blue huckleberry habitat type (Steele and Geier-Hayes 1987b). In general, sampling methods were similar to those used in the central Idaho habitat type study (Steele and others 1981). Circular plots (375 m² in size) were subjectively located so as to represent the range of site conditions and vegetal diversity characteristic of the habitat type. Recorded observations included age of last disturbance; plant coverage by species; percent age survival and age to 4.5 feet (1.4 m) of planted tree seedlings; occurrence of pocket gopher mounds and snow damage to tree seedlings; methods of logging, slash disposal, and site preparation; and thickness of duff layer. The plant coverage data (see appendix) were used to develop a succession classification (Steele 1984) and were later assembled in synthesis tables (Mueller-Dombois and Ellenberg 1974) to verify the early seral to climax arrangement of stands as indicated by the classification.

THE PSME/PHMA HABITAT TYPE

Distribution

In the *Pseudotsuga* series of the Northern Rockies, PSME/PHMA is second only to the Douglas-fir/pinegrass habitat type in extent of geographic distribution. PSME/PHMA ranges from northeastern Washington, northern Idaho, and adjacent British Columbia (Daubenmire and Daubenmire 1968) to northeastern Oregon (Hall 1973; Johnson and Simon 1987), central Idaho (Steele and others 1981), and western Montana (Pfister and others 1977). It also occurs in southeastern Idaho and western Wyoming (Steele and others 1983) and northern and central Utah (Mauk and Henderson 1984; Youngblood and

Mauk 1985). The *Pseudotsuga* / *Physocarpus monogynous* h.t. in north-central Wyoming (Hoffman and Alexander 1976) and north-central Colorado (Hess 1981) is similar in appearance but less productive.

This broad geographic distribution is accompanied by considerable diversity, part of which is characterized by phase designations (table 1). The occurrence of tree species by phase is shown in table 2. In northern Idaho, PSME/PHMA consists of two phases, a moist phase that can support *Larix* and has *Smilacina stellata* and *Disporum hookeri* as climax indicators (SMST phase) and a drier condition (PHMA phase) that does not support *Larix* or *S. stellata* and *D. hookeri*. These two phases have also been recognized in Montana (table 1). The drier PHMA phase is quite similar to the PIPO phase of central Idaho but should be distinguished from the original PHMA phase described in Montana (table 1).

In central Idaho, PSME/PHMA ranges in elevation from about 3,100 to 7,100 feet (945 to 2,164 m). It occurs on virtually every aspect but is most common on northerly (270° to 90° azimuth) slopes and least common on south to southwesterly slopes. In fact, only two out of 152 sample plots in central Idaho occurred on slopes having an azimuth between 180° and 225°. PSME/PHMA represents a relatively warm, moist environment and usually indicates a site with ample cold air drainage; rarely, if ever, does it occur in frost pockets. PSME/PHMA occurs on a variety of substrates that include basaltic, granitic, and sedimentary parent materials. It is most common in the Boise and Payette River drainages, but can be found in varying abundance in most major river drainages of central Idaho (fig. 1). Most PSME/PHMA in the Boise and Payette drainages occurs within the range of *Pinus ponderosa* and is designated the PIPO phase. Because this phase receives much more silvicultural activity than the other phases, it is the primary phase addressed in this report.

Eastward through central Idaho, PSME/PHMA extends into more severe environments where *Pinus ponderosa* is absent. These sites have been designated the PSME phase and are found in the more continental climate of east-central Idaho where they occur as high as 7,100 feet (2,164 m). The PSME phase also occurs sporadically along the juncture of the Snake River Plains and the Idaho batholith (fig. 1), where it occurs as low as 3,500 feet (1,067 m). In these areas the PSME phase is a topographic climax of north-slope canyon lands, which are generally associated with the Snake River Plain (where the climatic climax is nonforest). This contrasts with the adjacent mountains (where the climatic climax is forest) that support the PIPO phase. Apparently the adjacent mountain mass prolongs the benefits of passing storms through greater cloud cover and more moderate temperatures. Soil differences may also exacerbate these subtle climatic differences, which is often the case along the periphery of a plant species or habitat type distribution where conditions become most stressful. Total precipitation may be greater in the PIPO phase, but this is not likely a differentiating factor since the pine can occupy drier sites than *Pseudotsuga* or *Physocarpus* in areas where other factors are more favorable. Because of relatively little management activity in the PSME phase only sparse data are available for successional study.

Table 1—Phase designations of the PSME/PHMA h.t. suggested by various studies

Study	None	PHMA	PHMA -moist (SMST) ¹	PHMA -dry (PHMA)	CARU	PIPO ²	PSME	PAMY
Northern Idaho								
R. and J. Daubenmire (1968)	X ³	.	O	O	.	.	.	.
Daubenmire (1973)	.	.	X	X	.	.	.	.
Cholewa (1977)	X	.	O	O	.	.	.	.
Cooper and others (1987)	.	.	X	X	.	.	.	.
Western Montana								
Pfister and others (1977)	.	X	O	O	X	.	.	.
Arno and others (1985)	.	.	X	X	.	.	.	.
Eastern Oregon								
Hall (1973)	X	.	X	X	.	.	.	.
Johnson and Simon (1987)	X ⁴	.	.	O	.	.	.	.
Central Idaho								
Steele and others (1981)	.	.	.	.	X	X	X	.
Eastern Idaho-western Wyoming								
Steele and others (1983)	.	.	.	.	.	.	X	X
Utah								
Mauk and Henderson (1984)	X	.	.	.	.	.	.	O
Youngblood and Mauk (1985)	X	.	.	.	.	.	.	O

¹The moist and dry variants of the original PHMA phase in Montana (Pfister and others 1977) have been named the *Smilacina stellata* and *Physocarpus malvaceus* phases, respectively, in northern Idaho by Cooper and others (1987).

²The PIPO phase in central Idaho is similar to PHMA (dry).

³X = phase defined; O = phase suggested by data or text.

⁴These studies also describe a PSME/ACGL-PHMA association that closely resembles a moist extreme of the PIPO phase but is not transitional to the SMST phase.

Table 2—Occurrence of tree species in phases of the PSME/PHMA h.t.¹

ADP No.	Tree species	Phases				
		SMST	PHMA (dry)	PIPO	PSME	PAMY
001	<i>Abies grandis</i>	a ²	a	a	.	.
006	<i>Larix occidentalis</i>	S	a	.	.	.
010	<i>Pinus contorta</i>	s	(s)	.	(s)	a
011	<i>Pinus flexilis</i>	.	.	.	(s)	(s)
013	<i>Pinus ponderosa</i>	S	S	S	.	.
014	<i>Populus tremuloides</i>	.	(s)	(S)	a	(s)
015	<i>Pseudotsuga menziesii</i>	C	C	C	C	C

¹Derived from Cooper and others (1987), Arno and others (1985), Johnson and Simon (1987), Steele and others (1981, 1983).

²S = major seral a = accidental occurrence

s = minor seral () = occurs in only part of the phase

C = major climax.

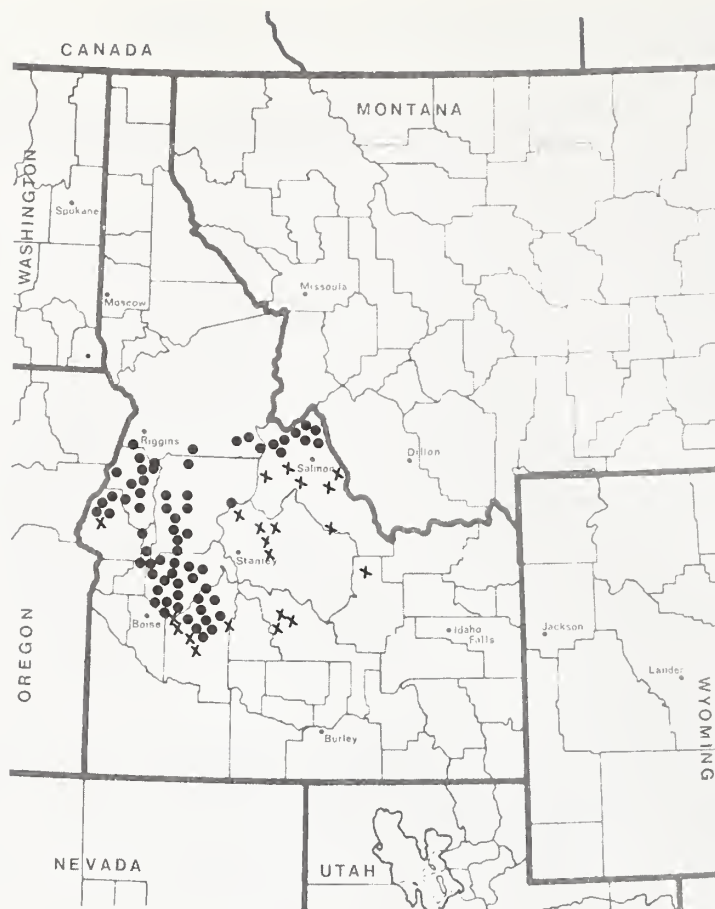


Figure 1—Distribution of the PSME/PHMA h.t. in central Idaho, PIPO phase (•) and PSME phase (x).

The CARU phase is reported for central Idaho and Montana (table 1) but is uncommon in Idaho. We intended to use this phase to delineate a broad transition between the PSME/PHMA and *Pseudotsuga menziesii*/*Calamagrostis rubescens* (PSME/CARU) habitat types. Unfortunately, the idea has limited value because some seral stages of the PIPO, or PHMA dry, phase can be easily misidentified as the CARU phase since these phases all support the same species. Although the CARU phase may exist in some areas its taxonomic use has been discouraged and its successional features have not been studied in Idaho or Montana (Arno and others 1985).

The PAMY phase (table 1) occurs mainly in southeastern Idaho, adjacent Wyoming, and northern Utah. Its southernmost occurrence lies in the northern Fish Lake Plateau of central Utah (Youngblood and Mauk 1985). This phase is a rather isolated geographic variant of PSME/PHMA. *Pinus ponderosa* is entirely absent but *Populus tremuloides* and occasionally *Pinus contorta* are common. Successional characteristics of this phase have not been studied.

Description (PIPO Phase Only)

In central Idaho, the PIPO phase occurs between 3,100 and 6,400 feet (945 and 1,951 m) in elevation and indi-

cates relatively warm, moist sites with good cold air drainage. At its moist extremes, this phase can support most species found in adjacent *Abies grandis* habitat types except the *Abies*. Eastward, beyond the range of *Abies grandis*, the PIPO phase may adjoin the Douglas-fir/mountain maple habitat type where cooler temperatures exclude *Physocarpus*. The dry limits of this phase are determined by the drought tolerance of *Physocarpus*. Wherever this shrub is unable to develop a canopy, the Douglas-fir/white spirea, Douglas-fir/pinegrass, or Douglas-fir/elk sedge habitat type will prevail, depending on slight differences in soil and topography. Seral communities within the PIPO phase can vary as a result of their proximity to these other habitat types.

EARLY SERAL

Early seral communities tend to reflect the greatest species diversity for a given habitat type. In PSME/PHMA, *Populus tremuloides* may dominate the tree layer, particularly on old landslides. But usually there is no early seral tree layer, and a dense shrub layer dominates the site. *Ceanothus velutinus* is usually a prevalent member of early seral stages, but in areas to the north and east of Banks, ID, *C. sanguineus* is the most common ceanothus. High coverages of either species usually reflect past burning; lesser amounts can result from

scarification. High coverages of *Ribes cereum* or *R. viscosissimum* also reflect early seral stages and are usually the result of scarification without burning. *Ribes viscosissimum* occurs mainly at the moist extremes of the PIPO phase, while *R. cereum* can occur throughout the phase. *Ribes*-dominated communities are relatively rare, however, possibly due to the difficulty of achieving thorough scarification on these steep sites.

Numerous herbaceous species can appear in the early seral stages. Annual species of *Gayophytum*, *Epilobium*, *Cryptantha*, *Polygonum*, *Clarkia*, *Bromus*, and occasionally other genera denote the earliest stages of herb layer succession. *Potentilla glandulosa*, *Rudbeckia occidentalis*, and sometimes *Agastache urticifolia* indicate heavily grazed conditions. Occasionally, *Iliamna rivularis* is prevalent where there has been severe burning such as from slash piles. *Bromus carinatus* and *Geranium* have high coverages where there has been little grazing or recovery from heavy grazing. These conditions often appear as a perplexing mosaic that is best interpreted through repeated observations of larger, more uniform areas where the vegetation has reacted to a single disturbance.

MID-SERAL

Mid-seral tree layers support a mixture of *Pinus ponderosa* and *Pseudotsuga*, proportions of which often reflect the nature and frequency of past wildfires or logging. As the tree canopy increases, the shrub layer also undergoes change. The shade-intolerant shrubs *Ceanothus* and *Ribes* decline, leaving the more tolerant *Salix* and *Prunus* as indicators of mid-seral stages. *Salix scouleriana* is often a prominent shrub at this stage. It establishes from seed or resprouts from stumps in early seral stages and develops a rounded shape in the full sun. But as the overstory shade increases, the *Salix* outline changes to a narrow upright growth form beneath openings in the tree canopy. *Prunus emarginata* and, less often, *P. virginiana* are also prevalent in some areas. These *Prunus* communities often appear somewhat stable, and many have a history of repeated wildfire. *Salix* and *Prunus* also exhibit subtle differences in site requirements. The *Prunus* species are more common on upper slopes and ridges (probably warmer) whereas *Salix* is more prevalent at mid-to-lower slope and in concave terrain (more moisture). These different site requirements become more apparent in progressively drier, more severe habitat types where both genera are seldom well represented on the same site. In the herbaceous layer, the early seral species decline substantially beneath the increased shade. More tolerant species such as *Penstemon attenuatus*, *Epilobium angustifolium*, and *Fragaria* may remain well represented. Climax taxa such as *Arnica*, *Calamagrostis*, and *Thalictrum* may already be dominating these mid-seral associates.

CLIMAX

In near-climax to climax stages, Douglas-fir is the dominant tree and often forms pure stands. But low coverages of ponderosa pine may persist due to that tree's greater height and long life span. Shrub layers become increasingly simple and consist mainly of *Physocarpus*, *Sym-*

phoricarpus oreophilus, *Amelanchier*, and *Spiraea*. The herbaceous layer has also decreased in species diversity and consists mainly of shade-tolerant rhizomatous species. *Aster conspicuus*, *Carex geyeri*, *Arnica*, *Calamagrostis*, and *Thalictrum* are the primary components of near-climax conditions.

SUCCESSIONAL FEATURES

Succession Classification

A systematic classification of seral vegetation within the PSME/PHMA h.t. was developed as part of this study. The basic approach (Steele 1984) uses indicator species according to their ability to dominate a seral stage and their relative successional amplitude (relative vulnerability to successional replacement). The relative amplitudes can be arranged along the successional gradient and are inversely related to indicator value. Figure 2 shows an example of this arrangement for the major tree species in PSME/PHMA. These indicators are then combined with possible dominant tree species to provide a temporal-structural framework for classifying seral tree layers. Figure 3 shows the classification framework derived from figure 2. Shade tolerance is often assumed to be the factor that determines successional amplitude, but, as Minore (1979) suggests, other competitive factors may be involved. Bazzaz (1979) addresses numerous physiological factors that affect a plant's ability to compete with its associates. Species longevity, light quality and nutrient requirements, allelopathic and disease resistance, and reproductive strategy are some of the factors involved. Fortunately, the integrated effects of all competitive factors, whether known or unknown, can be interpreted through relative successional amplitudes, which in turn provide a successional time scale for classification purposes. Using indicator species to delineate seral stages may be less than ideal for some applications but provides an ecologically based classification suitable for most resource management activities. In contrast, if time is used on a yearly scale to classify seral communities, the relationship becomes untenable due to the randomness of successional forces such as seed crops, insects, disease, weather, and combinations thereof.

The Tree Layer

Because tree, shrub, and herb layer succession occurs at different rates and may be affected by layer-specific disturbances, this classification focuses on the individual layers. The tree layer (trees more than 4.5 feet [1.4 m] tall) in PSME/PHMA is easy to classify because it contains only three major species. Relative successional amplitudes of these species are shown in figure 2. *Populus tremuloides* is clearly less tolerant than the associated conifers. *Pinus ponderosa* is less shade tolerant than *Pseudotsuga* (Minore 1979), and the pine seedlings will not survive beneath the denser canopy of *Pseudotsuga*. Once the older pines in the stand have declined and become poorly represented, another successional segment is delineated. The passing of each major seral species marks a segment in the successional sequence.

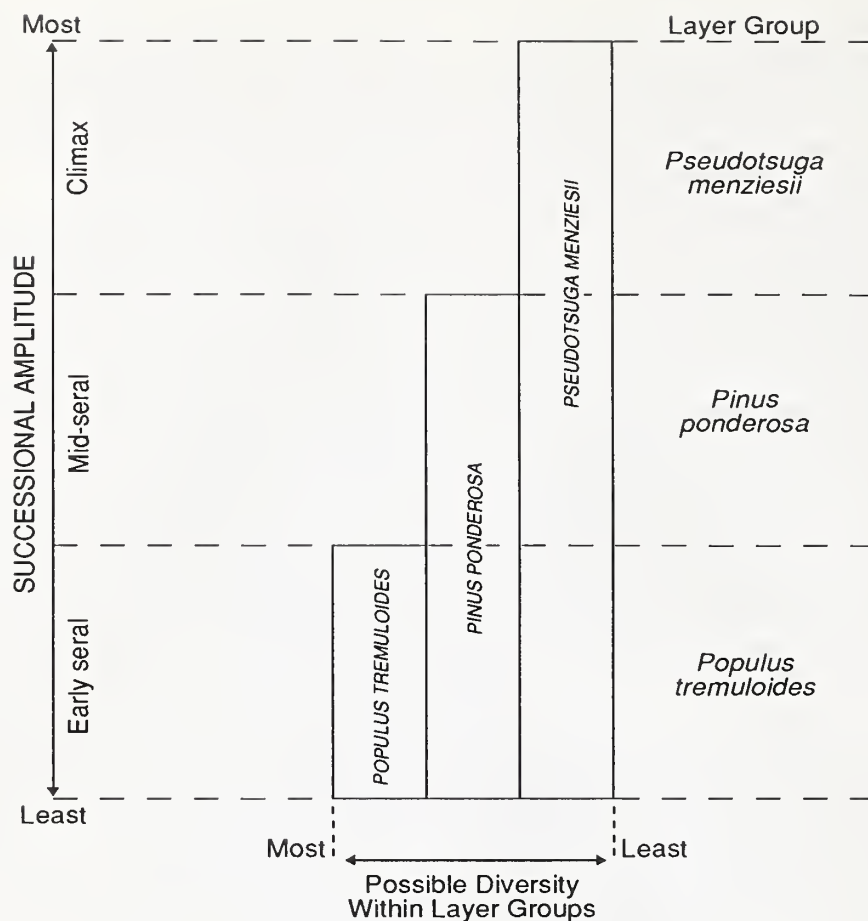


Figure 2—Relative successional amplitudes of major tree species in the PSME/PHMA h.t., PIPO phase.

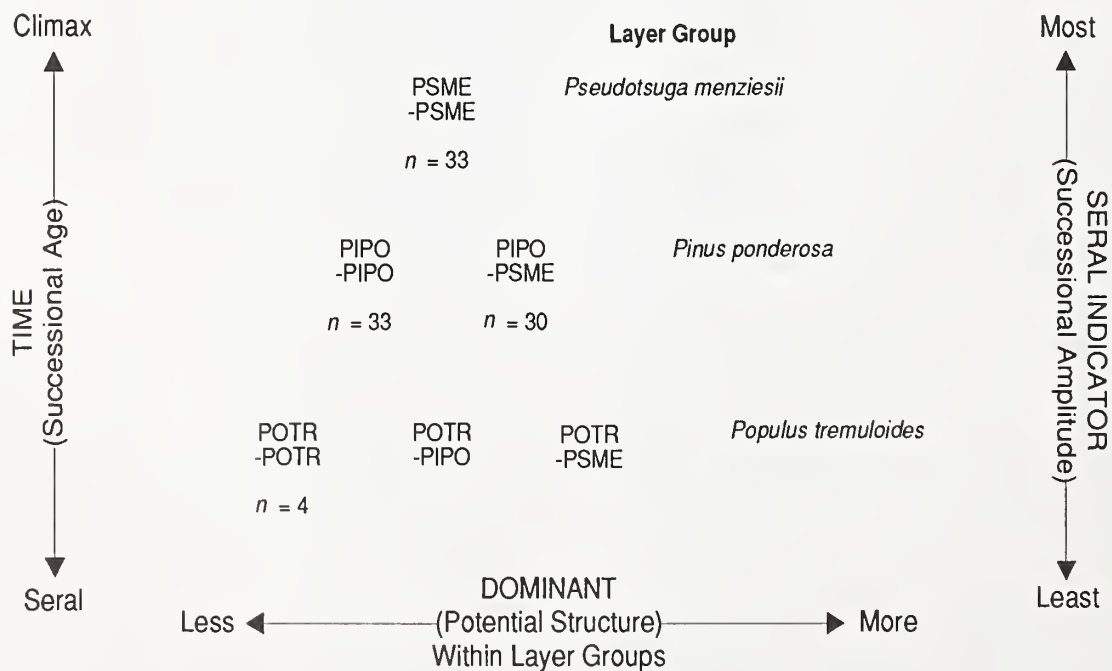


Figure 3—Succession classification diagram of the tree layer in the PSME/PHMA h.t., PIPO phase (n = number of samples in each layer type).

Pseudotsuga, being the most shade tolerant, has the greatest successional amplitude and acts as the climax tree. Although various factors often preclude the entire replacement sequence, the relative successional amplitudes have been established for classification purposes.

Figure 2 suggests that possible species diversity of the tree layer is greatest in the early seral stages. Here all three species could be well represented, although usually this is not the case. In the climax stage, however, only *Pseudotsuga* will be well represented, with all other tree species poorly represented or absent. A diminishing species diversity during secondary succession becomes more apparent in the shrub and herb layer classifications where more species occur.

Figure 3 shows the possible seral conditions in the tree layer that may converge to a common climax layer of *Pseudotsuga*. *Populus tremuloides* forms the base of the triangle because it has the least successional amplitude. Other species are arranged in ascending order as a reflection of their progressively greater successional amplitudes. Each taxonomic unit in figure 3 consists of a seral indicator species followed by the dominant species. In order to maintain a systematic structure, each taxonomic unit in figure 3 is called a layer type, and each group of layer types having the same seral indicator is called a layer group. Layer groups denote the various seral stages that are possible within a given habitat type or phase. Layer types within one layer group such as PIPO-PIPO and PIPO-PSME in the PIPO layer group denote the structural conditions that are possible in that particular seral stage. Similar classifications were developed for the shrub and herb layers. If desired, taxonomy of the tree, shrub, and herb layers can be combined to characterize the entire plant community.

In the PSME phase, only *Pseudotsuga* is well represented, so only a PSME-PSME tree layer type can result. This phase has an environment less favorable for other tree species than the PIPO phase so fewer species are well represented and consequently fewer tree layer types exist. The phase also occupies less area than the PIPO phase and experiences considerably less management activity. Consequently, there are insufficient data to develop specific management implications for this phase.

Delineating the vertical axis (successional time) into layer groups (fig. 3) provides an ecological basis for segmenting the succession. As succession progresses, a stand's classification status will progress from one layer group to a successional older layer group. For instance, *Pinus ponderosa* (well represented) may dominate the tree layer (PIPO-PIPO) or may be dominated by *Pseudotsuga* (PIPO-PSME). But the presence of *Pinus ponderosa* can always be interpreted as a specific segment of the succession because the potential to be outcompeted by *Pseudotsuga* always exists. *Pinus ponderosa* is unable to replace *Pseudotsuga* without the aid of disturbance but can always outcompete *Populus tremuloides*.

Figure 3 serves as a **classification diagram** (not a succession model) for seral tree layers in the PSME/PHMA h.t. These and the other diagrams herein do not outline actual successions for a given site, but rather illustrate the possibilities within the habitat type. Actual

successions skip many layer types and even layer groups within their respective diagrams. A succession can be described in terms of the layer types shown (fig. 3), but is determined by species composition of the stand and available seed sources.

Figure 3 also serves as a basis for constructing a simple key to tree layer types for field use. This is done by starting with the earliest layer group in figure 3 and progressing along the time gradient to climax (table 3). Keys to the shrub and herb layer types are constructed the same way. These keys are intended to be used in the same manner as the habitat type keys (Pfister and others 1977; Steele and others 1981).

SIZE CLASS NOTATIONS

The basic classification approach used in the tree, shrub, and herb layers was presented in figures 2 and 3 and table 3, but the tree layer progresses through recognizable size classes of development such as sapling (0.1-4 inches [0.25-10.2 cm] d.b.h.), pole (4-12 inches [10.2-30.5 cm]), mature (12-18 inches [30.5-45.7 cm]), and old-growth (>18 inches [45.7 cm]). These notations should be added so as to delineate stand structure even though they do not necessarily denote stand age. These notations are best added to each tree species after the tree layer type (l.t.) is identified, such as: mature PIPO-sapling PSME l.t. For consistency, the smallest size class that is well represented should be noted for the seral indicator because it usually reflects the most recent regeneration of that particular species. For the dominant species, the dominant size class should be used. When the seral indicator or the dominant species is well represented in the stand but not in any one size class, the size class with the most coverage should be noted. For convenience, size class notations can be abbreviated as follows: s. – sapling; p. – pole; m. – mature; and o.g. – old-growth.

It may be difficult, at first, to visualize some tree layer types in their appropriate successional position. For instance, a s. PSME – s. PSME l.t. may not seem to be successional older than an m. POTR – p. PSME l.t., because we normally think of time-related situations on a yearly (or age) scale. On a successional scale, however, a pure stand of sapling *Pseudotsuga* is closer to climax than a mixed older stand of *Populus* and *Pseudotsuga* because it will not go through the earlier seral stages of the POTR and PIPO layer groups. In fact, an s. PSME – s. PSME l.t. may even reach climax in fewer years because no species replacement (succession) is needed whereas an m. POTR – p. PSME l.t. must first lose the *Populus* and if *Pinus ponderosa* is well represented must also pass through a PIPO-PSME l.t. before reaching climax.

The three possible tree layer groups in PSME/PHMA (fig. 3) are described below and delineate tree layer succession into relatively broad segments. Because layer group delineations are usually based on a single indicator species, their origin can be related to a somewhat consistent set of site conditions. But progression from one layer group to another (and one layer type to another) depends on composition of the individual stand and is therefore predictable only from field observation. The following layer group descriptions are presented in the order they

Table 3—Key to tree layer group and layer types, with ADP codes, in the PSME/PHMA h.t.

	ADP codes
1. <i>Populus tremuloides</i> well represented ($\geq 5\%$) ¹ POTR Layer Group (Choose first condition that fits)	014
1a. <i>Populus tremuloides</i> dominant POTR-POTR Layer Type	014.014
1b. <i>Pinus ponderosa</i> dominant or codominant POTR-PIPO Layer Type	014.013
1c. <i>Pseudotsuga menziesii</i> dominant or codominant POTR-PSME Layer Type	014.016
1. <i>P. tremuloides</i> poorly represented ($< 5\%$) 2	
2. <i>Pinus ponderosa</i> well represented ($\geq 5\%$) PIPO Layer Group (Choose first condition that fits)	013
2a. <i>Pinus ponderosa</i> dominant PIPO-PIPO Layer Type	013.013
2b. <i>Pseudotsuga menziesii</i> dominant or codominant PIPO-PSME Layer Type	013.016
2. <i>P. ponderosa</i> poorly represented ($< 5\%$) 3	
3. <i>Pseudotsuga menziesii</i> well represented ($\geq 5\%$) PSME Layer Group	016
3a. <i>Pseudotsuga menziesii</i> dominant PSME-PSME Layer Type	016.016
3. <i>P. menziesii</i> poorly represented ($< 5\%$) depauperate or undescribed tree layer or not PSME/PHMA h.t.	

¹"Well represented" means canopy cover ≥ 5 percent regardless of diameter classes of the trees involved. Trees less than 4.5 feet (1.4 m) tall should be omitted from coverage estimates. "Dominant" refers to greatest canopy cover, "codominant" refers to nearly equal canopy cover. When keying to layer type, choose first condition that fits.

appear in the key (table 3). Constancy and average cover of species within sampled layer types appear in appendix A.

POPULUS TREMULOIDES LAYER GROUP (POTR L.G.)

Populus tremuloides can establish by seed on newly exposed mineral soil that remains moist during the critical germination period. Viability of freshly fallen seed usually exceeds 90 percent but lasts only about 3 weeks (Brinkman and Roe 1975). Occasional *Populus* seedlings have established in well-scarified areas, some drier than PSME/PHMA, but usually the young trees occur as root sprouts following fire or logging. If large *Populus* trees are cut or burned, their roots can produce numerous sprouts if sunlight is adequate. The sprouts provide excellent browse for deer and elk.

In the PSME/PHMA h.t., the POTR l.g. consists of three possible layer types (fig. 3). These layer types usually result from resprouting of scattered, often decadent, *Populus* following overstory removal by wildfire or logging. When *Populus* is present in the stand and no conifers establish soon after disturbance, a POTR-POTR layer type can result (fig. 4). In this layer type, subsequent invasion by conifers may be slow even when seed sources are nearby. Reasons for this are unclear, but Younger, Koch, and Kapustka (1980) have shown that leaf litter of *Populus tremuloides* can chemically inhibit seedling growth of several grasses. Possibly, conifer seedlings are also affected. Because the POTR-POTR layer type creates only light shade it can allow lush development of the shrub and herbaceous layers which also hinder conifer establishment. Simultaneous establishment of *P. ponderosa*, or *Pseudotsuga* with the resprouting of scattered *Populus*, can produce a POTR-PIPO or POTR-PSME layer type. Both of these can progress to a pine or Douglas-fir layer group more quickly than the POTR-POTR layer type.

Although relatively uncommon in PSME/PHMA, the POTR l.g. can be found on old landslides, the leeward sides of windswept ridges, and possibly elsewhere. It could develop on any site supporting *Populus tremuloides* if competing conifers are killed. Only four stands in this layer group have been found; all were in the POTR-POTR layer type. Stand ages ranged from 18 to 75 years; none showed recent invasion by conifers even though the oldest stand was bordered by an adequate seed source of *Pseudotsuga*.

PINUS PONDEROSA LAYER GROUP (PIPO L.G.)

By definition, *Pinus ponderosa* occurs throughout the PIPO phase of PSME/PHMA and, unless planted, is absent in the PSME and PAMY phases. *Pinus ponderosa* is the only major seral tree species found throughout the PIPO phase and is often prevalent in old-growth stands, yet it seldom colonizes recent clearcuts. Poor dispersion of the heavy seed and unsuitable seedbeds limit the pine regeneration. Distance to seed source and infrequent cone crops are often responsible for a scarcity of seed. Logging and high-intensity burning stimulate several shrub and herb layer species, which can quickly dominate potential pine seedbeds. As a result, natural establishment of *P. ponderosa* in large clearcuts is often slow and sporadic.

The PIPO layer group consists of two layer types in the PSME/PHMA h.t (fig. 3). Both of these layer types are quite common and were extensively sampled. The PIPO-PIPO layer type has resulted mainly from plantations, especially where the dominant size class is now saplings or small poles (appendix A). PIPO-PIPO in the larger size classes resulted either from shelterwood and seed-tree cuts or wildfire within the past 50 years (fig. 5). PIPO-PSME layer types were dominated mainly by pole-size or larger trees. This layer type resulted mostly from wildfire 50 to 100 years ago.



Figure 4—A pole POTR-pole POTR tree layer type west of Idaho City, ID, in 1985. This area was cleared by wildfire in 1931. The *Populus* probably was here prior to the fire and simply resprouted. This clone has been increasing its size and now covers several acres. An occasional *Pseudotsuga* seedling is the only conifer present after 5 decades. Both *Pinus ponderosa* and *Pseudotsuga* seed sources occur within 200 feet (61 m).



Figure 5—A pole PIPO-mature PIPO tree layer type in the Andersen Creek drainage east of Crouch, ID, in 1979. This site experienced a surface fire in 1931, and most of the *Pinus ponderosa* survived. Since then *Pseudotsuga* saplings have accumulated in the understory and created fuel ladders into the pine canopy. The entire stand was lost to wildfire in 1986.



Figure 6—A pole PSME-mature PSME tree layer type southwest of Idaho City, ID, in 1979. This 90-year-old stand of *Pseudotsuga* apparently originated following a severe wildfire in about 1889. It has escaped subsequent wildfire as evidenced by the many dead tree branches still attached near ground level. Because no species replacement is possible, this tree layer has reached climax in one generation.

Prior to settlement by Euroamericans, wildfire burned PSME/PHMA sites at frequent intervals. In west-central Idaho, fire frequency ranged from about every 13 years in the dry extremes of PSME/PHMA to about every 22 years in the moist extremes (Steele and others 1986). Wildfires at these frequencies were most likely low-intensity surface fires, that killed most of the young *Pseudotsuga* in the stand but not the more fire-resistant pine (Arno 1976). Even young pines are fairly resistant to low-intensity surface fires, and the eventual result was an accumulation of pine dominating the site. Today, in the absence of frequent surface fires, these PIPO-PIPO layer types are difficult to achieve naturally but are being replaced by many pine plantations. Unlogged sites that now burn infrequently often develop high coverages of *Pseudotsuga*, resulting in the PIPO-PSME layer type. Selective cutting of the pine in PIPO-PSME has quickly advanced succession to the PSME layer group.

PSEUDOTSUGA MENZIESII LAYER GROUP (PSME L.G.)

Pseudotsuga is the only tree species that occurs throughout the range of PSME/PHMA and, being the most tolerant, acts as the climax species. In general, climax species are more difficult to establish than seral species, and *Pseudotsuga* is no exception. Most plantings of *Pseudotsuga* have failed in the PSME/PHMA h.t., and natural regeneration is usually slow to establish and appears to need protection from sun and wind. It is likely that most existing stands of *Pseudotsuga* developed gradually beneath the canopy of either seral trees or shrubs.

As climax, the PSME layer group consists of only one layer type, PSME-PSME (fig. 3). This layer type can occur in nearly pure stands of sapling, pole, and mature trees as well as old-growth. Regardless of tree size, the PSME-PSME layer type is considered closest to climax on a successional scale because no successional replacement of tree species will occur and the climax species is already dominant (fig. 6). Compared to other tree layer types in PSME/PHMA, PSME-PSME generally has the greatest hazard potential for catastrophic fire, insects (spruce budworm), and disease (dwarf mistletoe). Silvicultural options also become more limited due to the prevalence of these hazards and the scarcity of seral tree species in the stand.

MANAGEMENT IMPLICATIONS

The following management implications were derived from data and repeated field observations taken during this study and the habitat type study (Steele and others 1981). Because of the often small sample size of the data set and the minimal amount of field testing and user response, the reader should exercise caution in implementing trace findings. Nevertheless, trends reflected by these data are logical and support the management implications.

Pocket Gophers—It has long been known that pocket gophers (*Thomomys talpoides*) can damage pine plantations (Dingle 1956; Moore 1943). Reasons for this damage have been studied at length. In summarizing gopher-related studies, Teipner and others (1983) suggest that gopher damage to young pines may be related to amount

Table 4—Occurrence of pocket gopher mounds following various site disturbances in the PSME/PHMA h.t., PIPO phase

Site treatment	Number of sites	Mound occurrence ¹
Clearcut, broadcast burned, or stand destroyed by wildfire	28	25(68) - 7(37)
Clearcut, broadcast burned, and scarified	6	50(65) - 7(21)
Clearcut and contour terraced	9	11(20) - 18(13)
Clearcut, unburned, and scarified	17	71(129) - 11(10)
Partial cut and scarified	5	60(138) - 15(13)
Clearcut and no site preparation	18	11(25) - 10(12)

¹Expressed as: percentage constancy (average number/acre) - average years since disturbance of sites with mounds (average years since disturbance of sites without mounds).

and composition of plant species as well as gopher density. Our studies indicate that plant species composition can vary with type of site preparation for tree planting which, in turn, may influence gopher populations. Therefore, pocket gopher mounds were tallied (Richens 1965) in our sample plots and then summarized by site treatment.

Although gopher mounds are common on disturbed sites in PSME/PHMA, they occur most frequently in cut-over areas that have been well scarified but not burned (table 4). Gopher mounds also occur most frequently on unburned scarified areas in several other habitat types (Steele and Geier-Hayes 1984, 1985, 1986, 1987b). The gophers, of course, do not respond directly to the site treatment but rather to the resulting vegetation. Thorough scarification, either by machines or heavy livestock use, generates early seral herbaceous layers which likely stimulate gopher populations. In contrast, burning without scarification can result in a depauperate herb layer by generating a dense shrub layer. Burning can also result in mid- to late seral herbaceous layers, which apparently have less appeal to gophers. (See herb layer section for further discussion.)

Planted Tree Establishment—Planted sites were identified from plantation signs and obvious rows of even-aged trees. Seedling survival was estimated in percentage and recorded for each site preparation technique. Site preparation included no preparation, hand scalps, scarification with and without burning, and contour terraces. Hand scalping was grouped with no preparation because it usually did not reduce long-term competition and because it could not always be recognized in older plantations. Scarification treatments usually resulted from stripping, pile and burn operations, or extensive machinery traffic during logging. Scarification treatments are uncommon, however, on many of the steeper slopes associated with this habitat type.

Contour terraces varied in width from 2 to 3 feet on more gentle terrain to 6 to 8 feet on the steeper slopes. During the 1950's and 1960's, terraces were used mainly for establishing ponderosa pine seedlings in areas that had been burned by wildfire and had become dominated by tall shrubs. Seedling survival was generally high. Because some terraces were installed on unstable hillsides the practice was discontinued. These terraces result in a horizontal tread across the slope and a large amount of

soil displacement. Terraces built with large bulldozers were wide and displaced considerable soil but ideally were widely spaced on the slope so as to reduce erosion. Contour ditches appear to have the same effect on pine survival as contour terraces, thus both treatments are grouped in this report. In contrast, the ditches were usually built with a large plow and resulted in much less soil displacement than the terraces. Ditches have proven to be effective where the residual plant competition is low in height, such as pinegrass, elk sedge, spirea, and common snowberry. Contour ditches are also effective in ninebark when the shrub layer is relatively low. Unfortunately, use of contour ditches was also discontinued when the terraces earned disfavor.

In the PIPO phase of PSME/PHMA, survival of planted *Pinus ponderosa* (table 5) was greatest (about 76 percent after 13 years) on contour terraces or ditches (fig. 7). These treatments apparently improve the soil moisture regime by collecting runoff and by removing the stored seed and root crowns of competing plant species. Improved survival of planted pines on contour terraces and ditches has also been noted in other Douglas-fir habitat types (Curtis and Coonrod 1960; Hall and Curtis 1970; Steele and Geier-Hayes 1984, 1986). But this treatment does not necessarily improve survival in grand fir habitat types where soil moisture is usually adequate for ponderosa pine (Steele and Geier-Hayes 1985, 1987b).

Other site treatments, such as burning and scarification, can result in substantially lower pine survival than contouring (table 5). These treatments do not decrease competing vegetation, especially rhizomatous species, as effectively as contour terraces or ditches and do not concentrate soil moisture for the tree seedling. With burning, plant competition is often increased by stimulating certain species to sprout vigorously or to germinate from buried seed. Unless plantations are established the spring following the burning, the planted trees are at a serious disadvantage as the competition increases. Scarification usually destroys aboveground portions of competing vegetation, and some shallow rooted species, but often allows more deeply rooted species to resprout and stimulates some species to germinate from buried seed. As in most habitat types, plantations with little or no site preparation tend to have the poorest survival (table 5). Lack of any disturbance simply allows existing competition to strengthen their dominance without interruption.

Table 5—Success of tree plantations by site treatment in the PSME/PHMA h.t, PIPO phase

Tree species	Site treatment ¹			
	None (includes hand scalps)	Broadcast burning	Scarified unburned (includes stripping)	Contour terraces (includes ditching)
Survival of planting, percent (average age) ²				
PIPO	20(26) <i>n</i> = 5	40(20) <i>n</i> = 2	28(14) <i>n</i> = 8	76(13) <i>n</i> = 11
PSME	0(16) <i>n</i> = 1	—	—	—
Average age to breast height, years				
Planted ³				
PIPO	10 <i>n</i> = 4	8 <i>n</i> = 2	9 <i>n</i> = 6	8 <i>n</i> = 9
PSME	—	—	—	—

¹*n* = number of sample sites.

²Plantings less than 4 years old were omitted; complete plantation failures were not always recognized and multispecies plantings could not be sampled for survival.

³Nursery years are not included.



Figure 7—An old plantation of *Pinus ponderosa* on contour terraces. During the 1960's many of these plantations were installed on contour terraces and ditches in PSME/PHMA. They have proven highly successful for pine regeneration where soil stability can be maintained.

The survival percentages in table 5 may differ from Ranger District records for two reasons. First, the data reflect planting attempts over many years and many early planting failures were due to factors other than site treatment and habitat type. Second, the data reflect seedling success over the past 10 to 30 years whereas District records are generally maintained for only a few years after planting and do not reflect the long-term effects of site and competition. Our figures are not necessarily the highest possible survival rates because, occasionally, high

survival has been achieved in several treatment categories. Our survival rates are best interpreted as a relative probability of success rather than expected percentage of survival.

Age to Breast Height—The years required for a tree to reach breast height (4.5 feet [1.4 m]) can be a critical factor in estimating growth and yield parameters of forest stands as well as seedling success against competing vegetation. Normally an estimated constant is used for a given species regardless of site. Yet for some species,

sample data have shown considerable variability in breast height ages between habitat types and even between site treatments within a habitat type. In PSME/PHMA, breast height age for planted *Pinus ponderosa* is about 8 to 9 years regardless of site treatment (table 5). A lack of site preparation, however, may extend breast height age to 10 years and in some cases up to 13 years.

Date are scarce for planted *Pseudotsuga* in the PIPO phase but a few natural seedlings reached 4.5 feet (1.4 m) in about 14 years.

Snow Damage to Pine Plantations—Extensive snowpack damage to ponderosa pine plantations was previously noted in the grand fir/mountain maple habitat type (Steele and Geier-Hayes 1985) and led to an assessment of similar damage in PSME/PHMA. The damage is sustained mainly by trees greater than 4.5 feet (1.4 m) tall. It varies from stripped lateral branches and bent terminals to permanent 90-degree angles in the main stem and entire saplings pushed into semiflattened positions. Stem internodes indicate that, once damaged, the pine's growth rate is reduced for a year or more, making the young tree more vulnerable to shrub competition. With lodgepole pine, Rehfeldt (1987) noted a similar loss in growth rate of 22 percent. Long-term snow records suggest that subsequent damage may occur about every 4 years, causing accumulated deformities (Megahan and Steele 1987). In spring, these bent, stunted trees remain beneath the snow longer than undamaged trees and during prolonged snowmelt can suffer increased mortality from the brown-felt blight (*Neopeckia coulteri*).

In PSME/PHMA, most pine saplings situated below 5,200 feet (1,585 m) in elevation escape serious snow damage although the main stems and lateral branches may be temporarily deformed at elevations as low as 4,800 feet (1,463 m). As elevation increases above 5,200 feet (1,585 m), damage potential also increases. But damage may be less severe on northerly aspects (between 340° and 20° azimuth) or under certain site conditions described below. Slope steepness is a relatively minor variable because most slopes in PSME/PHMA are steep enough to cause snow movement. At the uppermost elevations of PSME/PHMA, snow damage is apt to occur on any aspect but can be alleviated by certain conditions. For instance, pine plantations near ridgetops may escape snow damage within the hazard zone. Likewise, plantations that are well shaded in early spring by a nearby ridge or adjacent old-growth stand may escape damage. Sites with high stumps and large logs which limit snow movement can also reduce snow hazards. Proper location and treatment of cutting units can exploit these advantages where high damage potential exists.

In contrast, potential snow damage can be increased by contour terraces. In steep terrain, these terraces are often quite wide and accumulate more snow than adjacent slopes. Terrace cutbanks create a steepened sliding surface that exacerbates snow movement. The pines planted closest to the cutbank are most apt to be damaged while those nearest the fill slope often escape damage.

Extent of snow damage within plantations can vary from scattered individual trees at lower elevations to

virtually all trees at the upper elevations. Trees having only light damage (bent terminals) generally recover as described by Oliver (1970) unless repeatedly damaged. Severely damaged trees probably could recover but are usually situated so as to receive repeated snow damage, making full recovery unlikely.

Proper genetic seed source is a critical factor in snow damage susceptibility and recovery (Rehfeldt and Cox 1975). In central Idaho, ponderosa pine displays a number of growth-related variations that can be viewed as genetic adaptation (Rehfeldt 1986). In general, plantations from lower elevation seed sources have higher growth potentials, longer periods of annual elongation, and are more apt to sustain permanent damage in the snow hazard zone. Trees from upper elevation seed sources display less growth potential, shorter periods of annual elongation, and tend to sustain less snow damage and recover more readily. In some areas, upper elevational limits of ponderosa pine may not be due to low temperatures but rather deep snowpacks. Consequently, at upper elevations where the pine occurs naturally in only minor amounts, even pine plantations of the proper seed source may experience reduced stocking levels and may not be a major component of the stand by rotation age. Selecting seed origins having inheritable stockiness (Silen and Rowe 1971) and planting the seedlings at greater densities may overcome this problem, but that has yet to be proven. Recognizing snow damage potential can be difficult in many areas, but it is an important consideration when planting ponderosa pine on PSME/PHMA sites above 5,200 feet (1,585 m) in elevation.

Growth and Yield Capability—Height-age data of free-growing trees, usually in clearcuts or burns, were collected during the course of this study. These data provided growth information for the younger age classes of major tree species in PSME/PHMA. Similar data in older age classes were taken from dominant or codominant trees in old-growth stands during this study and the habitat type classification study (Steele and others 1981). Increment cores of these older trees were examined for evidence of suppression. If the core indicated past suppression, or if it was too far from the pith to allow a confident estimate of total age, the tree was rejected. Remaining data were used to estimate site index and yield capability.

The basis for estimating site index and yield capability are from three sources. The *Pseudotsuga* site index was plotted from Monserud's (1985) site curves but because no yield tables exist for *Pseudotsuga*, Brickell's (1970) ponderosa pine yield curve was used. The *Pinus ponderosa* site index and yield capability were derived from Brickell's (1970) site curves, which are a conversion to a 50-year base age from Lynch (1958).

Growth and yield capabilities of the PSME/PHMA h.t., PIPO phase are shown in table 6. Ponderosa pine apparently produces only slightly more volume than Douglas-fir. But if Douglas-fir yield tables were developed, yield differences between the two species may actually be greater.

Table 6—Growth and yield characteristics of trees in the PSME/PHMA h.t., PIPO phase

Tree species	Number of site trees	Site index (50-year base)	Number of stands	Yield capability
<i>Pseudotsuga menziesii</i>	n = 24	60±6 ¹	n = 24	Ft ³ /acre/year 83±13
<i>Pinus ponderosa</i>	n = 25	62±4	n = 14	84±8

¹95 percent confidence intervals.

The Shrub Layer

Shrub layer succession is more diverse and less easily interpreted than that of the tree layer. Environmental variation within the habitat type also contributes to this diversity. The dry extreme of PSME/PHMA h.t., PIPO phase usually merges with the Douglas-fir/white spiraea (PSME/SPBE) habitat type and the moist extreme merges with grand fir/mountain maple (ABGR/ACGL) or Douglas-fir/mountain maple (PSME/ACGL). Shrub layer succession near these extremes often resembles that of the adjacent site more than a modal PSME/PHMA site.

The important shrub layer species in PSME/PHMA are listed in table 7. Among the 151 shrub layers sampled in the PSME/PHMA h.t., PIPO phase, there are seven major seral species and nine alternates. The alternate species often occur in only part of the habitat type and for classification

purposes are grouped with more widespread species having similar successional strategies and amplitudes. For instance, *Ceanothus sanguineus*, which occurs at lower elevations in PSME/PHMA, is grouped with *C. velutinus* because of similar seed storage capabilities, shade tolerances, and responses to burning; *Symphoricarpos oreophilus* is grouped with *Amelanchier* because both species are disseminated mainly by rodents and birds, are nonrhizomatous, and can persist beneath a moderately dense tree canopy. *Philadelphus* is grouped with *Salix* because both species tend to colonize bare mineral soil, are nonrhizomatous, and have moderate shade tolerance. *Acer* and *Vaccinium* were grouped with *Physocarpus* as climax species. A few other taxa such as *Rosa* and *Berberis* were only occasionally well represented and were not used for classification purposes.

Relative successional amplitudes of major shrub species in PSME/PHMA provide the basis for shrub layer classification and are shown in figure 8. These amplitudes were derived from many field observations and sample data (appendix B-1). They are meaningful only in a relative sense because there is no scale for measurement. Ideally, relative amplitudes should be established through studies of many permanent plots over many decades, but rarely is such a study ever attempted. Consequently, accuracy of relative amplitudes (fig. 8) varies from well-established trends (as in the tree layer) to the author's best guess. The certainty of this accuracy is greatest for the species farthest apart (fig. 8). For example, *Ceanothus* and *Ribes* clearly have less successional amplitude than *Physocarpus* (fig. 8), but the relative amplitudes of *Salix* versus *Prunus* are less certain. Consequently, when determining relative amplitudes one must use the "philosophy of successive approximations" (Poore 1962) as a scientific basis for developing hypotheses for each species followed by testing through field observation and data analysis.

From the relative amplitudes (fig. 8), a succession classification diagram for shrub layers is easily constructed (fig. 9). The classification consists of seven shrub layer groups and 28 layer types (fig. 9). Of the 28 possible layer types, 23 occur in the present data set (fig. 9). The remaining five layer types may be found with more reconnaissance, may appear only after uncommon disturbances (or disturbance combinations), or may be rare under any circumstance.

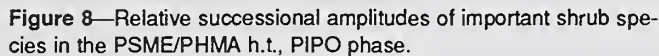
The classification diagram (fig. 9) is easily converted to a systematic key for field use (table 8). Indicator species (of layer groups) appearing early in the key have the least successional amplitude and so have greater indicator value than species with more amplitude, which appear progressively later in the key. This same ranking of

Table 7—Occurrence and roles of major shrub species in the PSME/PHMA h.t. in central Idaho

ADP No.	Species	Abbreviation	Role ¹	
			PIPO phase	PSME phase
102	<i>Acer glabrum</i>	ACGL	(C)	(c)
105	<i>Amelanchier alnifolia</i>	AMAL	S	(S)
203	<i>Berberis repens</i>	BERE	c	(c)
107	<i>Ceanothus velutinus</i>	CEVE	S	(S)
198	<i>Ceanothus sanguineus</i>	CESA	(S)	-
173	<i>Cercocarpus ledifolius</i>	CELE	-	(S)
119	<i>Philadelphus lewisii</i>	PHLE	(S)	(s)
122	<i>Physocarpus malvaceus</i>	PHMA	C	C
123	<i>Prunus emarginata</i>	PREM	S	a
124	<i>Prunus virginiana</i>	PRVI	S	(S)
128	<i>Ribes cereum</i>	RICE	S	S
131	<i>Ribes viscosissimum</i>	RIVI	(S)	(s)
136	<i>Rubus parviflorus</i>	RUPA	(S)	-
137	<i>Salix scouleriana</i>	SASC	S	(s)
142	<i>Spiraea betulifolia</i>	SPBE	S	(S)
143	<i>Symphoricarpos albus</i>	SYAL	(S)	(s)
163	<i>Symphoricarpos oreophilus</i>	SYOR	S	S
146	<i>Vaccinium globulare</i>	VAGL	(C)	-

¹S = major seral
s = minor seral
C = major climax
c = minor climax

a = accidental
() = occurs in only part of the phase,
usually the moister portion or the
warmer-drier portion.



The range of years since disturbance of sampled layer types appears in appendix B-1; averages are given when three or more known ages exist per layer type. The low extreme of each range is meaningless because any layer type could have been recently disturbed; in these cases only disturbance intensity would vary between layer

15

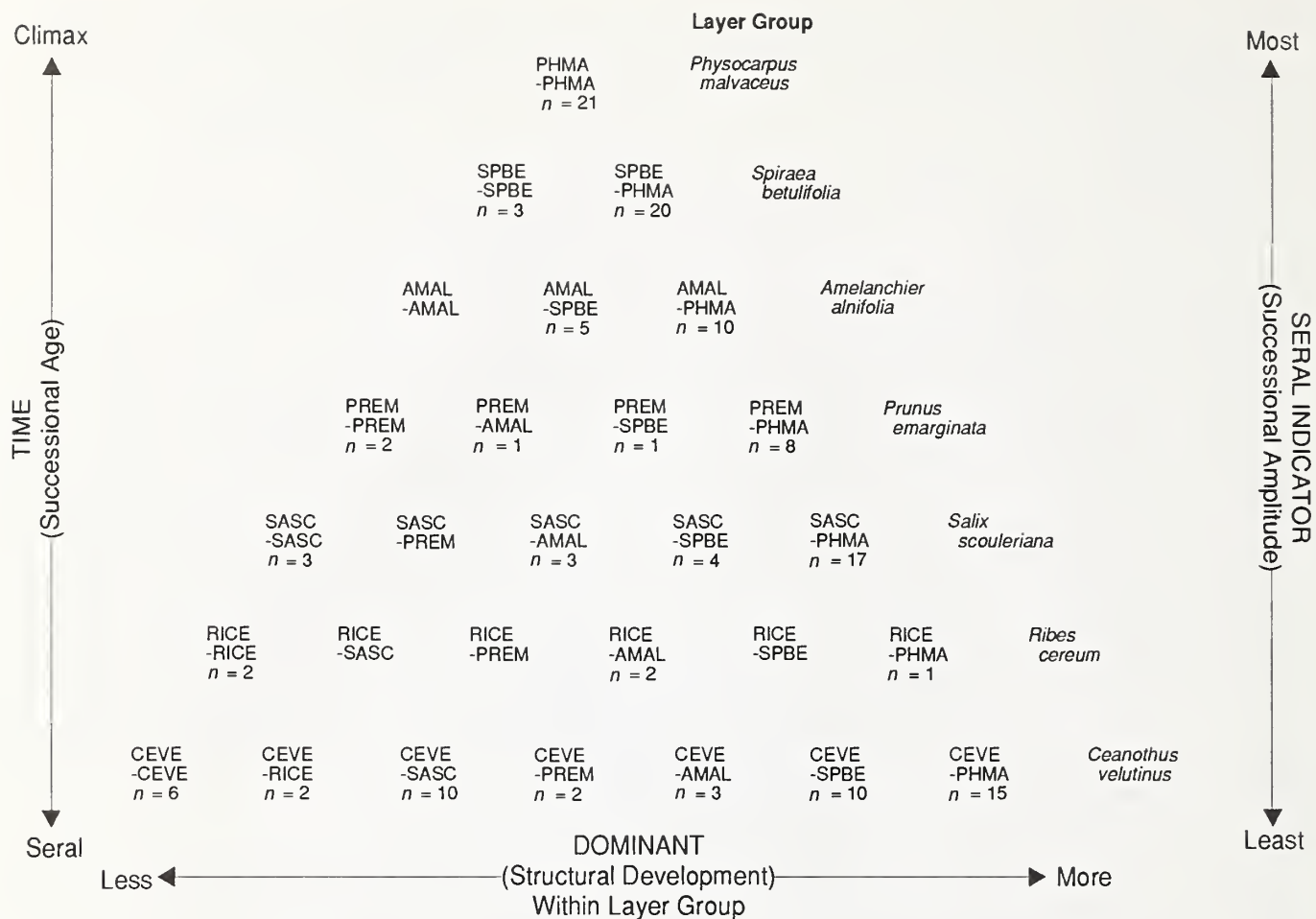


Figure 9—Succession classification diagram of the shrub layer in the PSME/PHMA h.t., PIPO phase (*n* = number of samples in each layer type).

Table 8—Key to shrub layer groups and layer types, with ADP codes, in the PSME/PHMA h.t., PIPO phase

	ADP codes
1. <i>Ceanothus velutinus</i> (incl. <i>C. sanguineus</i>) well represented ($\geq 5\%$) ¹ CEVE Layer Group	107
(Choose first condition that fits)	
1a. <i>Ceanothus</i> spp. dominant CEVE-CEVE Layer Type	107.107
1b. <i>Ribes</i> spp. dominant or codominant CEVE-RICE Layer Type	107.128
1c. <i>Salix scouleriana</i> dominant or codominant CEVE-SASC Layer Type	107.137
1d. <i>Prunus</i> spp. dominant or codominant CEVE-PREM Layer Type	107.123
1e. <i>Amelanchier</i> (incl. <i>Symphoricarpos oreophilus</i>) dominant or codominant CEVE-AMAL Layer Type	107.105
1f. <i>Spiraea</i> (incl. <i>Symphoricarpos albus</i> and <i>Rubus parviflorus</i>) dominant or codominant CEVE-SPBE Layer Type	107.142
1g. <i>Physocarpus</i> dominant or codominant CEVE-PHMA Layer Type	107.122
1. <i>Ceanothus</i> poorly represented ($< 5\%$) 2	
2. <i>Ribes cereum</i> (incl. <i>R. viscosissimum</i>) well represented ($\geq 5\%$) RICE Layer Group	128
(Choose first condition that fits)	
2a. <i>Ribes</i> spp. dominant RICE-RICE Layer Type	128.128
2b. <i>Salix scouleriana</i> dominant or codominant RICE-SASC Layer Type	128.137
2c. <i>Prunus</i> spp. dominant or codominant RICE-PREM Layer Type	128.123
2d. <i>Amelanchier</i> (incl. <i>Symphoricarpos oreophilus</i>) dominant or codominant RICE-AMAL Layer Type	128.105
2e. <i>Spiraea</i> (incl. <i>Symphoricarpos albus</i> and <i>Rubus parviflorus</i>) dominant or codominant RICE-SPBE Layer Type	128.142
2f. <i>Physocarpus</i> dominant or codominant RICE-PHMA Layer Type	128.122
2. <i>Ribes</i> spp. poorly represented ($< 5\%$) 3	
3. <i>Salix scouleriana</i> well represented ($\geq 5\%$) SASC Layer Group	137
(Choose first condition that fits)	
3a. <i>Salix</i> dominant SASC-SASC Layer Type	137.137
3b. <i>Prunus</i> spp. dominant or codominant SASC-PREM Layer Type	137.123
3c. <i>Amelanchier</i> (incl. <i>Symphoricarpos oreophilus</i>) dominant and codominant SASC-AMAL Layer Type	137.105
3d. <i>Spiraea</i> (incl. <i>Symphoricarpos albus</i> and <i>Rubus parviflorus</i>) dominant or codominant SASC-SPBE Layer Type	137.142
3e. <i>Physocarpus</i> dominant or codominant SASC-PHMA Layer Type	137.122
3. <i>Salix</i> poorly represented ($< 5\%$) 4	
4. <i>Prunus emarginata</i> (incl. <i>P. virginiana</i>) well represented ($\geq 5\%$) PREM Layer Group	123
(Choose first condition that fits)	
4a. <i>Prunus</i> spp. dominant PREM-PREM Layer Type	123.123
4b. <i>Amelanchier</i> (incl. <i>Symphoricarpos oreophilus</i>) dominant or codominant PREM-AMAL Layer Type	123.105
4c. <i>Spiraea</i> (incl. <i>Symphoricarpos albus</i> and <i>Rubus parviflorus</i>) dominant or codominant PREM-SPBE Layer Type	124.142
4d. <i>Physocarpus</i> dominant or codominant PREM-PHMA Layer Type	123.122
4. <i>Prunus</i> poorly represented ($< 5\%$) 5	
5. <i>Amelanchier</i> (incl. <i>Symphoricarpos oreophilus</i>) well represented ($\geq 5\%$) AMAL Layer Group	105
(Choose first condition that fits)	
5a. <i>Amelanchier</i> (incl. <i>Symphoricarpos oreophilus</i>) dominant AMAL-AMAL Layer Type	105.105
5b. <i>Spiraea</i> (incl. <i>Symphoricarpos albus</i> and <i>Rubus parviflorus</i>) dominant or codominant AMAL-SPBE Layer Type	105.142
5c. <i>Physocarpus</i> dominant or codominant AMAL-PHMA Layer Type	105.122
5. <i>Amelanchier</i> and <i>Symphoricarpos</i> poorly represented ($< 5\%$) 6	
6. <i>Spiraea betulifolia</i> (incl. <i>Symphoricarpos albus</i> and <i>Rubus parviflorus</i>) well represented ($\geq 5\%$) SPBE Layer Group	142
(Choose first condition that fits)	
6a. The above species dominant SPBE-SPBE Layer Type	142.142
6b. <i>Physocarpus</i> dominant or codominant SPBE-PHMA Layer Type	142.122
6. The above species poorly represented ($< 5\%$) 7	
7. <i>Physocarpus malvaceus</i> well represented ($\geq 5\%$) PHMA Layer Group	122
7a. <i>Physocarpus</i> dominant PHMA-PHMA Layer Type	122.122
7. <i>Physocarpus</i> poorly represented ($< 5\%$) depauperate or unclassified shrub layer	

¹"Well represented" means canopy coverage ≥ 5 percent. "Dominant" refers to greatest canopy coverage regardless of height, "codominant" refers to nearly equal canopy coverage. When keying to layer type, choose first condition that fits.

CEANOTHUS VELUTINUS LAYER GROUP (CEVE L.G.)

Ceanothus velutinus is a shade-intolerant nonrhizomatous shrub. It has no apparent means of long-distance seed dispersal, but some of its seed are likely eaten and transported by small birds. Chipmunks were frequently seen feeding on the fruits and may provide short-distance dispersal. Most seed, however, simply falls to the ground and can remain viable in the soil and duff for at least 200-300 years (Gratkowski 1962) and possibly over 500 years (Zavitkovski and Newton 1968). The small hard seeds germinate readily following burning, and the young plants can grow 4 to 6 feet tall in about 10 years. *Ceanothus* density is often directly proportional to burning intensity, and severely burned areas can produce thickets that discourage access by man and livestock. In some areas, particularly to the north and east of Banks, ID, *C. sanguineus* occurs instead of *C. velutinus*, but its successional role appears similar. On slopes overlooking the Snake River canyon, neither species of *Ceanothus* is present on many PSME/PHMA sites; reasons for this absence are not known. Elsewhere in the PSME/PHMA h.t., PIPO phase, at least one species of *Ceanothus* is usually present either in the form of shrubs or seed. The occurrence of *Ceanothus* shrubs along roads and other disturbed areas usually indicates that viable *Ceanothus* seed exists on adjacent timbered sites where the shrubs are absent (Kramer 1984).

The CEVE layer group represents some of the most common early seral shrub layers in PSME/PHMA, especially in the PIPO phase. Here, all seven of the CEVE layer types that may occur were found (fig. 9). These layer types usually reflect various severities or frequencies of burning. Severe burns that kill existing shrubs are usually the least frequent and can produce the CEVE-CEVE layer type. Less severe burning of climax shrub layers can produce the CEVE-PHMA layer type. Various burning intensities of other seral stages may produce the other CEVE layer types (fig. 9) depending on the preburn species composition. Sometimes CEVE layer types will appear following light scarification (fig. 10), but their development is usually less dense. Severe scarification is likely to produce the CEVE-RICE layer type that usually has a sparse shrub canopy.

The CEVE layer types are perhaps the easiest to achieve following disturbance and in PSME/PHMA respond dependably to moderate or severe burning. Following severe burning a dense CEVE-CEVE layer type will develop and deter livestock and erosion. Moderate burning can result in a less dense canopy that provides shelter and nutrients for *Pseudotsuga* seedlings (Youngberg and others 1979). Some CEVE layer types have high forage value for deer and elk, and the nests of small birds were frequently found in these shrub layers. CEVE layer types in general can progress successionaly to most other shrub layer groups, but the progression of individual stands to other layer types is determined by species composition and canopy cover (appendix B-2).



Figure 10—A CEVE-AMAL shrub layer type in the Bannock Creek drainage southeast of Idaho City, ID. This site was clearcut 17 years ago. The logging slash was pushed downslope with a bulldozer, causing light scarification. *Ceanothus* germinated from buried seed in response to the increased sunlight and soil disturbance. *Amelanchier* and *Symphoricarpos oreophilus* probably occurred here prior to logging and simply resprouted with renewed vigor. They now codominate the shrub layer.

RIBES CEREUM LAYER GROUP (RICE L.G.)

The RICE layer group is denoted mainly by *Ribes cereum*, but *R. viscosissimum* and small amounts of other *Ribes* species may be present. These *Ribes* are characteristically early seral nonrhizomatous shrubs, often the first to dominate well-scarified sites. Having a low tolerance for shade, they begin declining shortly after a canopy taller than their own develops. The *Ribes*, however, seem to maintain their coverages toward climax longer than *Ceanothus* and so are considered slightly less vulnerable to succession. Like *Ceanothus*, numerous seed of *Ribes* fall to the ground and remain viable in the soil and duff long after the parent shrubs have disappeared. But because *Ribes* have a fleshy fruit, many seeds are also dispersed by various birds and mammals. The *Ribes* seed, however, are not as ubiquitous on PSME/PHMA sites as are *Ceanothus* seed. Kramer (1984) found *Ribes* seed in only 6 percent of the old-growth PSME/PHMA sites as opposed to 75 percent for *Ceanothus*. *Ribes cereum* is known to have some allelopathic capability (Heisey and Delwiche 1983), but its effectiveness on PSME/PHMA sites has not been studied.

RICE layer types are uncommon in PSME/PHMA; only three out of the six possible layer types were found (fig. 9). These layer types generally result from various intensities of scarification. Thorough scarification that reduces the *Physocarpus* will likely result in a RICE-RICE layer type, whereas light scarification would result in RICE-PHMA. Because most slopes in PSME/PHMA are too steep for machine scarification, RICE layer types are uncommon even when adequate *Ribes* seed is present. RICE layer types usually result from scarification, which reduces existing shrubs; therefore these layer types have some of the lowest forage values for big game and the least competition for tree seedlings. The RICE layer types sampled are progressing toward the AMAL and PHMA layer groups (appendix B-3).

SALIX SCOULERIANA LAYER GROUP (SASC L.G.)

Salix scouleriana is a nonrhizomatous shrub that has high value for big-game browse (appendix B-1). It can also provide nesting and feeding habitat for small birds. *Salix* has light, windblown seeds that are dispersed in late spring, have a short-lived viability, and require moist mineral soil for germination (Brinkman 1974). Though only slightly tolerant of shade, its tall growth habit—up to 25 feet (7.6 m) in PSME/PHMA—enables it to persist in small openings on well-timbered sites. Its rapid sprouting ability allows it to recover quickly when tree competition is removed. In clearcuts, *Salix* may enhance *Pseudotsuga* establishment by protecting the site from sun and wind, but it is a formidable competitor of *Pinus ponderosa* seedlings. Having a low tolerance for shade, the pine must outgrow *Salix* in order to survive. This is barely possible because planted pine and *Salix* seedlings have similar growth rates for about the first 8 years in PSME/PHMA. But *Salix* sprouting from stumps can outgrow the pine in the first year, thus adjacent pine seedlings have little chance for survival. High densities of *Salix* in uncut stands may require mechanical or chemical treatment following clearcutting where pine plantations are a man-

agement objective. However, mechanical removal of large old-growth *Salix* can displace considerable soil. Also, *Salix* stems severed in the process may produce new plants if in contact with moist soil. Appropriate chemicals would control the *Salix* with less impact on the site.

The SASC layer group represents a mid-seral stage of shrub layer succession and consists of five layer types in PSME/PHMA (fig. 9). Four of these have been sampled. Much of this layer group, and especially the SASC-PHMA layer type, has resulted from severe wildfires that have occurred since the early 1900's. Many broadcast burn operations, however, do not burn hot enough to create an adequate seedbed for *Salix*. Such treatments usually generate a CEVE layer type that has little *Salix* and bypasses the SASC layer group during succession. Recently, SASC layer types have resulted from mechanical scarification in clearcuts, especially where exposed soil was mounded so as to trap water, thus creating well-watered seedbeds of mineral soil. This situation generally produces a SASC-SASC layer type. Most of the SASC layer types that were sampled are progressing toward SPBE- and PHMA-dominated layer types (appendix B-4).

PRUNUS EMARGINATA LAYER GROUP (PREM L.G.)

Prunus emarginata and the alternate indicator, *P. virginiana*, are moderately shade-tolerant shrubs. They generate many root sprouts and tend to form thickets that provide important food and cover for wildlife. Birds and mammals disperse the heavy flesh-covered seed in the fall. These seeds can remain viable in the soil and duff for many years (Kramer 1984). The seed has an embryo dormancy (Grisez 1974) that is offset by winter conditions. It germinates in early spring and probably responds best to broadcast burning. *Prunus emarginata* is more common in PSME/PHMA than is *P. virginiana* and appears to be slightly less shade tolerant.

PREM layer types represent mid-seral stages of shrub layer succession. All four layer types were found (fig. 9), but only the PREM-PHMA layer type is common. Although it is not known how all PREM layer types are formed, some obviously result from succession of CEVE layer types. Other PREM layer types appear to have been burned repeatedly by wildfire. Apparently, the *Ceanothus* that germinated after these fires has been reduced by shrub layer succession or had little seed stored in the soil at the time of the last fire. Still other PREM layer types exist on scarified sites, but these appear to be predisturbance shrub layers that merely survived the scarification. Although it is not yet known how PREM layer types can be generated directly, deep and thorough scarification or a chemical treatment is needed to remove these communities. It may also be possible to replace PREM layer types with CEVE layer types through severe burning if sufficient fuels exist. In this case, a CEVE-PRVI layer type is most likely to occur. Most PREM layer types that were sampled are progressing toward PHMA-dominated layer types (appendix B-5).

Although not widespread in PSME/PHMA, the PREM layer types have considerable value for wildlife. The fleshy fruits of *Prunus*, *Amelanchier*, *Rosa*, and *Symphoricarpos* can provide abundant food for grouse, numerous

songbirds, small rodents, and black bear. Leaves and twigs of these shrubs are desirable browse for deer and elk. Although other shrub layers in PSME/PHMA have greater forage value for big game, the PREM layer types should have some of the highest values for birds and small mammals.

AMELANCHIER ALNIFOLIA LAYER GROUP (AMAL L.G.)

Amelanchier alnifolia is a nonrhizomatous shrub that occurs in many shrub layer types. It produces a fleshy fruit that is eaten by many birds and mammals which, in turn, disperse the seed. *Amelanchier* seedlings are often found growing in dense clusters as if from a seed cache made by a small rodent. The seedlings are mostly found in scarified soil under partial shade. This shrub has moderate to high forage value for deer, elk, and black bear (appendix B-1). Being of moderate shade tolerance, *Amelanchier* is often well represented on timbered sites as well as open brushfields. In full sun, *Amelanchier* grows rapidly, but beneath a tree canopy its coverage declines more slowly than most other seral shrubs, making it an indicator of late seral conditions.

Symphoricarpos oreophilus is considered an alternate indicator of the AMAL layer group because it is similar to *Amelanchier* in several ways and appears to have a similar successional amplitude. *Symphoricarpos oreophilus* must be distinguished from *S. albus*, which is a rhizomatous shrub and ecologically more similar to *Spiraea* than *Amelanchier*. *Symphoricarpos oreophilus* is a nonrhizomatous, moderately shade-tolerant shrub that is widespread in central Idaho. It produces a fleshy fruit which, though not eagerly sought, is likely dispersed by birds and mammals. Small *Symphoricarpos* seedlings are usually found growing in dense clusters as if from a cache made by a small rodent. This shrub has low to moderate forage value to large herbivores (appendix B-1) and is often well represented on timbered sites as well as deforested areas. Its deep root system enables it to survive most burning and scarification site treatments.

The AMAL layer group consists of three layer types, two of which were sampled (fig. 9). The AMAL-SPBE layer type occurred mainly in clearcut areas that had received either no site treatment or ineffective broadcast burns or scarification. This layer type likely existed prior to the clearcutting, although it may have been in less vigorous condition. The AMAL-PHMA layer type occurred on sites that had been either clearcut with no site treatment or had been deforested or underburned by wild-fire 50 to 90 years ago. Thus it appears that AMAL layer types are mainly the result of successional advance rather than a particular site disturbance and can be maintained by clearcutting without additional treatment. All of these layer types were progressing toward SPBE and PHMA layer types (appendix B-6).

SPIRAEA BETULIFOLIA LAYER GROUP (SPBE L.G.)

Spiraea betulifolia is a moderately shade tolerant rhizomatous shrub with root development well into the soil profile. Mechanical scarification and stripping seldom completely remove the *Spiraea* root system, which will

resprout within the next growing season. *Spiraea* produces a small seed that has no obvious means of dispersal although occasional transport by small birds and rodents as well as strong winds seems likely. *Spiraea* seedlings are rarely found. Being rhizomatous, *Spiraea* usually grows in extensive colonies and has moderate forage value for mule deer and elk (appendix B-1). Its canopy cover declines quite slowly beneath a tree overstory, making it an indicator of late seral to climax conditions. In drier portions of PSME/PHMA, which often border the Douglas-fir/white spiraea habitat type, *Spiraea* may persist as a climax component of the shrub layer. In much of the PSME/PHMA habitat type, however, *Spiraea* gradually gives way to *Physocarpus*, making it a late seral indicator.

Symphoricarpos albus and *Rubus parviflorus*, though slightly more shade tolerant than *Spiraea*, are treated as successional equivalents. They, too, develop an extensive rhizomatous root system that usually resprouts following scarification of the site. These two species also provide moderate forage for deer and elk as well as some food for black bear (appendix B-1). In contrast to *Spiraea*, *Symphoricarpos albus* and *Rubus* do not occur throughout PSME/PHMA but are restricted to moister portions of the habitat type, particularly on finer textured or depositional soils. Like *Spiraea*, they may be part of the climax shrub layer in some situations but for classification purposes are treated as indicators of late seral conditions.

The SPBE layer group consists of two layer types, both of which were sampled (fig. 9). These two layer types result mainly from successional advance of early and mid-seral layer types containing *Spiraea*, *Symphoricarpos albus*, or *Rubus*. Out of 23 sample stands, only one SPBE layer type apparently resulted from a direct disturbance. Most of the others had been burned 30 to 125 years ago; many of these fires did not destroy the tree canopy, so that CEVE layer types either did not develop or declined rapidly. A few sample stands had experienced recent clearcuts with no site treatment, and the shrub composition remained unchanged. Although all SPBE-SPBE layer types were progressing toward SPBE-PHMA, only half of the SPBE-PHMA layer types appeared capable of progressing toward PHMA-PHMA (appendix B-7). The other half occurred on sites that appeared too dry for *Physocarpus* to outcompete *Spiraea* and had apparently reached their successional endpoint.

PHYSOCARPUS MALVACEUS LAYER GROUP (PHMA L.G.)

Physocarpus malvaceus is a shade-tolerant shrub that can form a layer above those of *Spiraea*, *Symphoricarpos*, and *Rubus* and gradually prevail as the climax dominant. Its coverage can be reduced by mechanical scarification, and repeated burning, but its potential for resprouting from an extensive root system can result in rapid recovery. *Physocarpus* produces a small, dry seed that can remain viable in the soil and duff (Kramer 1984). The seeds have no obvious means of transport but are likely dispersed by small birds and rodents.

Acer glabrum is a common associate of *Physocarpus* and may be well represented in climax stands. Occasionally *Vaccinium globulare* occurs as a climax component in the cool, moist extremes of the PSME/PHMA h.t. Both the



Figure 11—A PHMA-PHMA shrub layer type in Logging Gulch southeast of Idaho City, ID. This area was clearcut 10 years ago and given no site treatment. The shrub layer, mainly *Physocarpus*, existed prior to logging and has now developed a dense vigorous canopy as evidenced by the profuse flowering. Due to the dense shrub canopy, tree regeneration is now limited to the few *Pseudotsuga* saplings that survived the logging.

Acer and *Vaccinium* are treated as alternate successional indicators of *Physocarpus* in this habitat type.

Because the PHMA layer group represents climax conditions, only one layer type exists. The PHMA-PHMA layer type is the result of long-term succession and is not apt to be achieved through site manipulation. In most sampled stands the last disturbance was apparently wild-fire about 48 to 160 years ago. Occasionally, climax stands that are clearcut with no site treatment remain in this shrub layer type. This creates an "unnatural" situation for conifer regeneration because there are no seral areas in which conifers may establish. Also, the increased sunlight allows *Physocarpus* to develop a vigorous canopy that can create too much competition for conifer seedlings (fig. 11).

MANAGEMENT IMPLICATIONS

The previous sections describe some layer groups that can be achieved through prescribed site treatments and others that result mainly from uninterrupted succession. The actual layer type that may result from a particular site treatment can often be projected on a stand-by-stand basis from species composition and known successional response. When land managers consider the possible shrub layer types that can result from alternative site treatments, they may also want to consider the relative forage value of these layer types for big game and livestock. Such values can be estimated from relative palatability ratings of plant species for elk (Kufeld 1973), deer (Kufeld and others 1973), cattle and sheep (USDA FS 1986), and black bear (Beecham 1981). The usual scale of

1 to 3 in these studies was expanded to 1 to 6 so as to emphasize the differences in palatability values. The relative palatability value for each plant species is listed in appendix B-1. This value was multiplied by the constancy (percentage occurrence in stands) and average canopy cover (appendix B) for that species in a given layer type. This step was repeated for all species in the layer type. The sum of all such products within a layer type resulted in a forage index value for that particular layer type. The index values were then reduced to classes in order to simplify forage value assessments and to eliminate the false impression of high precision between values (table 9).

These index classes reflect forage potential on a relative basis but do not necessarily reflect actual use, which is affected by juxtaposition of the surrounding vegetational types. Some index values may be biased by consistent disproportions of canopy cover to shrub volume. Likewise actual palatability within a species can vary with plant vigor; however, other sources of variation common to this type of comparison have been reduced. For instance, the possibility of species ecotypes having different palatabilities is reduced by restricting the data to one habitat type. Individual animals may have slightly different forage preferences, but all possible layer types can be made available to the same group of animals. Plant species palatabilities are listed by season to accommodate seasonal forage preferences. In spite of the shortcomings inherent with these kinds of comparisons, the forage index classes can provide general guidelines to relative browse potential for specific wildlife and range objectives

Table 9—Relative index classes to big-game and livestock forage preferences by shrub layer types in the PSME/PHMA h.t., PIPO phase¹

Layer group layer type	No. of stands	Deer		Elk		Cattle	Sheep	Black bear		
		SU ²	W	SU	W	SU	SU	SP	SU	F
<i>Ceanothus velutinus</i>										
CEVE-CEVE	6	36	4	6	6	2	3	0	0	0
CEVE-RICE	2	2	1	4	1	2	2	1	2	2
CEVE-SASC	10	7	3	4	6	3	4	0	1	1
CEVE-PREM	2	3	2	4	2	2	2	1	2	2
CEVE-AMAL	3	5	4	6	5	3	4	1	2	3
CEVE-SPBE	10	4	2	3	4	2	3	0	1	1
CEVE-PHMA	15	4	2	4	3	2	3	0	1	1
<i>Ribes cereum</i>										
RICE-RICE	2	1	1	2	1	1	2	1	2	1
RICE-AMAL	2	3	2	3	1	2	3	1	2	2
RICE-PHMA	1	2	1	3	1	1	2	0	1	1
<i>Salix scouleriana</i>										
SASC-SASC	3	4	1	2	3	2	3	0	1	1
SASC-AMAL	3	4	2	3	4	2	4	1	2	2
SASC-SPBE	4	5	2	3	3	2	3	1	1	1
SASC-PHMA	17	5	2	4	3	2	4	1	1	1
<i>Prunus emarginata</i>										
PREM-PREM	2	4	2	5	3	2	3	1	3	4
PREM-AMAL	1	4	3	4	2	2	3	1	2	2
PREM-SPBE	1	2	1	2	1	1	2	0	1	1
PREM-PHMA	8	4	2	4	2	2	3	1	1	2
<i>Amelanchier alnifolia</i>										
AMAL-SPBE	5	4	2	3	4	2	4	0	1	1
AMAL-PHMA	10	5	3	4	4	3	4	0	1	1
<i>Spiraea betulifolia</i>										
SPBE-SPBE	3	3	3	3	4	2	3	1	2	2
SPBE-PHMA	20	4	2	3	3	2	4	0	0	0
<i>Physocarpus malvaceus</i>										
PHMA-PHMA	21	3	2	3	2	2	3	0	0	0

¹Based on palatability ratings by Kufeld (1973), Kufeld and others (1973), USDA FS (1986), and Beecham (1981).

²SP = spring (March, April, May); SU = summer (June, July, August); F = fall (September, October, November); W = winter (December, January, February).

³Code to index classes: 0 = 0-50; 1 = 51-150; 2 = 151-250 (low)
3 = 251-350; 4 = 351-450; 5 = 451-550 (moderate)
6 = 551-650; 7 = 651-750; 8 = 751-850 (high).

as well as multifunctional planning. Range and wildlife managers who may have better species palatability ratings for a local area can recalculate the forage indexes from appendix B, reduce the indexes to index classes (table 9), and apply the results to their area.

Forage index classes (table 9) vary according to kinds and amounts of plant species comprising the layer type. Because early seral layer types may contain more species than later stages, a greater data base may be needed to reflect the modal conditions and forage indexes. When the same layer type occurs in different habitat types or phases, species composition may increase with site potential, and more samples may be needed for the more productive sites. The index value, however, is most affected by coverages of the highly palatable species and does not

necessarily increase with site productivity although this often is the case. Ranking of species' nutritional value between habitat types and seral stages could add refinement to the index values. Such considerations should be used when comparing relative significance of forage index classes.

Deer—Shrub layer forage values for deer herds in summer are mostly moderate (table 9). Some exceptions are high values in the CEVE-CEVE and CEVE-SASC layer types (caused by intense burning) and low values in CEVE-RICE, RICE-RICE, and RICE-PHMA layer types (caused by scarification). In winter, forage values are low to moderate throughout PSME/PHMA succession. The highest values occur in the CEVE-CEVE and CEVE-

AMAL layer types. CEVE-CEVE can be created by intense broadcast burning, whereas CEVE-AMAL is most likely to occur by burning other shrub layer types having a high frequency of *Amelanchier*.

Elk—Summer forage values for elk are mostly moderate but are high in the CEVE-CEVE and CEVE-AMAL layer types (table 9). These two layer types also had the highest value for deer in winter. Forage values for elk in winter are mostly low to moderate but rank high in the CEVE-CEVE and CEVE-SASC layer types. Both of these layer types result from clearcutting followed by intense burning.

Cattle—Shrub layer forage values for cattle are low in most seral stages of PSME/PHMA. Moderate forage values occur only in the CEVE-SASC, CEVE-AMAL, and AMAL-PHMA layer types. The occurrence of *Amelanchier* in these layer types, as opposed to its alternate indicator, *Symphoricarpos oreophilus*, appears to be the main forage species.

Sheep—Forage values for sheep are generally moderate throughout PSME/PHMA succession (table 9). Only the CEVE-RICE, CEVE-PREM, RICE-RICE, and RICE-PHMA layer types ranked low. Most shrub layer types rank higher for sheep than for cattle. Several layer types in the CEVE and PREM layer groups rank higher for deer or elk than for sheep.

Black Bear—There is only low food value for black bear in most stages of PSME/PHMA succession (table 9). Two exceptions are the CEVE-AMAL and PREM-PREM layer types, which ranked moderate due to high coverages of *Amelanchier* and/or *Prunus*. These two species also occur in other shrub layer types but did not have adequate canopy cover to rank high or moderate in bear forage value. The late summer to early fall fruit crops of these two shrub species provide the increased forage.

Planted Tree Seedlings and Shrub Competition—Potential competition of shrubs with tree seedlings is a function of existing vegetation, seed availability, site treatment, and habitat type or phase. The habitat type or phase classifies the environment, which in turn determines which species can occur on the site and the magnitude of their potential roles. For instance, *Acer* and *Physocarpus* can produce a major shrub layer in PSME/PHMA but are of little or no importance in the drier Douglas-fir habitat types. Predicting what species might occur or dominate by simply inspecting a site prior to disturbance is not always possible. Old-growth stands may contain a multitude of early seral species in the form of buried seed (Kramer 1984); other species establish by windblown seed. Table 10 shows which shrubs in PSME/PHMA store seed in the soil and important methods of seed dissemination, vegetative increase, and germination response to site treatment. Potential shrub competition for a given site is best estimated by noting kinds and amounts of existing shrubs on that site, the other species that may occur (table 7), and reactions of all species to the site treatment planned (table 10). This set of interacting variables is complex but provides an ecological basis for site-specific prescribed treatments. In contrast, general-

ized descriptions of site treatment and potential shrub responses tend to represent an average stand condition. Such predictions can be misleading for site-specific management because few stands would match the average condition.

The following paragraph describes how components of tables 7 and 10 and figure 6 can be assembled to meet site-specific conditions. Considerations for each stand may differ but should include:

1. The desired tree species, its shade tolerance and growth rate;
2. Kind and intensity of site treatment in terms of reducing existing competition;
3. Existing shrub species and their potential for reacting to the proposed timber harvest and to the site treatment selected;
4. Potential reactions of buried seed and windblown seed to the site treatment selected; and
5. Duration of the potential competition in terms of height-age interactions of shrub species and tree seedlings.

Duration of competition for tree seedlings depends on height-age interactions with the shrubs. For instance, *Pinus ponderosa* seedlings may become overtopped by *Ribes* seedlings from years 2 to 7 (fig. 12). The *Ribes* canopy, however, is usually sparse and should not seriously jeopardize pine survival. If free from suppression, properly planted *Pinus ponderosa* can outgrow most shrubs germinating from seed at the time of planting, but if the pines are planted after the first growing season following the disturbance, shrubs germinating from seed may seriously outcompete the pine (figs. 13a, b). Nevertheless, even pines planted the first growing season may not outcompete shrubs growing from sprouts. For example, *Pinus ponderosa* seedlings may overtop *Amelanchier* sprouts in about 10 years but are likely to be outcompeted by *Salix* sprouts (fig. 12). The pine's growth rate, however, is also affected by shrub density, which can be regulated by the kind and intensity of site disturbance (table 10). For instance, clearcutting can result in major canopy increases of *Salix* and *Prunus* that are already present on the site. Clearcutting followed by mechanical scarification can generate large amounts of *Ribes* from buried seed but only minor amounts of other shrub seedlings (table 10). When selecting a treatment to minimize certain shrub species, one must also guard against the possibility of greatly increasing some other species. For instance broadcast burning results in minor amounts of most shrubs from seed but generates major amounts of *Ceanothus*. Consequently the optimum treatment for any given site depends on the existing shrub layer as well as the potential for shrub seedlings.

Natural Tree Establishment—Naturally established tree seedlings were recorded by species, silvicultural treatment, and microsite conditions. A seedling was defined as a tree less than 4.5 feet (1.4 m) tall and 3 years old or older, but younger than the disturbance.

A total of 337 natural *Pinus ponderosa* and *Pseudotsuga menziesii* seedlings per acre were recorded in the PSME/PHMA h.t., PIPO phase. Most of these (82 percent) were

Table 10—Responses of major shrub species to various disturbances in the PSME/PHMA h.t., PIPO phase

Species	Seed transport; reproduction methods	Maximum heights	Type of disturbance				
			CC, NP	SC, MS	CC, MS	CC, BB	WF
		<i>Feet</i>					
PHMA	No obvious transport; seed stored in soil (11% viable). ¹ Germinates in partial shade on scarified soil. Increases by root sprouts.	3 - 5	V	V-s	V	V	V
ACGL	Wind; not stored in soil. Germinates in partial shade on scarified soil. Stumps resprout.	10 - 15	V	V-s	V	V	V
VAGL	Birds, mammals; stored in soil (23% viable). Germinates in partial shade on moist soil. Increases by shallow rhizomes.	2 - 2 ¹ / ₂	v	V-s	v	v	v
RUPA	Birds, mammals; stored in soil (14% viable). Increases by rhizomes.	2 - 3	V	V	V	V	V
SYAL	Birds, mammals; not stored in soil. Increases by rhizomes.	1 - 2 ¹ / ₂	V	v	V	V	V
SPBE	No obvious transport; not stored in soil. Increases by rhizomes.	1 - 1 ¹ / ₂	V	v	V	V	V
AMAL	Birds, mammals; not stored in soil. Germinates on bare soil in partial shade. Stumps resprout.	6 - 8	v	v-s	v-s	v-s	v-s
SYOR	Birds, mammals; not stored in soil. Germinates on bare soil in partial shade. Stumps resprout.	2 - 3	v	v-s	v-s	v-s	v-s
PREM and PRVI	Birds, mammals; stored in soil (27% viable). Germinates in full sun following scarification or burning. Increases by root sprouts.	7 - 12	V	v	V-s	V-s	V-s
SASC	Wind; not stored in soil. Germinates on moist mineral soil in full sun. Stumps resprout.	15 - 25	V	v	V-s	V-s	V-s
PHLE	No obvious transport; storage capability unknown. Germinates in full sun. Stumps resprout.	4 - 8	v	v	v-s	v-s	v-s
RICE and RIVI	Birds, mammals; stored in soil (96% viable). Germinates on mineral soil in full sun.	3 - 5	v	v-s	v-S	s	s
CEVE and CESA	No obvious transport; stored in soil (91% viable). Germinates mainly from burning and partially from scarification in full sun.	4 - 6	v	v	v-s	S	S

DISTURBANCE CODES:

CC, NP = Clearcut, no site preparation

SC, MS = Shelterwood cut, mechanical scarification

CC, MS = Clearcut, mechanical scarification

CC, BB = Clearcut, broadcast burned

WF = Stand-destroying wildfire

RESPONSE CODES:

V = Major vegetative response (coverage increases from existing plants and vigorous sprouting following tree removal but is offset by treatment intensity).

v = Minor vegetative response (coverage increases either from just the existing plants following tree removal or from existing plants and nonvigorous sprouting but is offset by treatment intensity).

S = Major response from seed (coverage increase depends on amount of viable seed available and is enhanced by treatment intensity).

s = Minor response from seed (same criteria as for S).

¹Stored seed viabilities are from Kramer (1984).

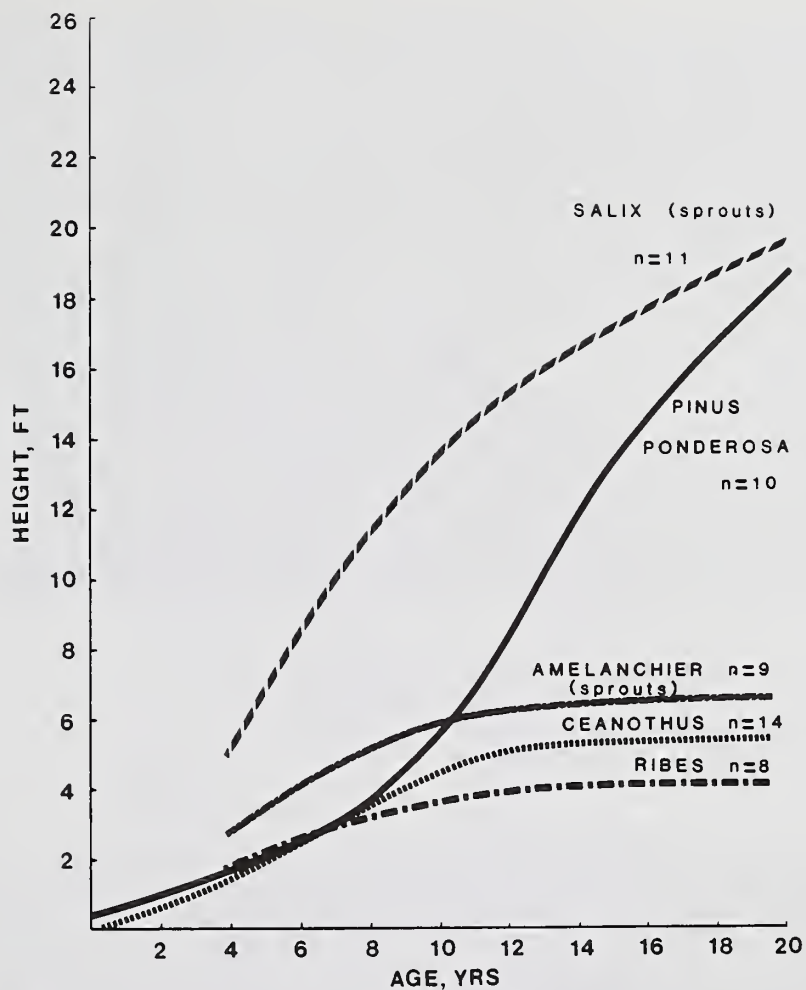


Figure 12—Height-age relationships of planted free-growing PIPO seedlings and important free-growing shrub species in the PSME/PHMA h.t., PIPO phase.



Figure 13a—A site that was clearcut and broadcast burned 4 years ago in 1975. This site was planted to ponderosa pine the spring following burning, but survival was poor. It was replanted in the fall 2 years later (in 1978). A shrub layer of *Ceanothus* from buried seed and *Physocarpus* from sprouts is now in its fourth growing season.



Figure 13b—Same site as above in 1986, 11 years after broadcast burning. The pine seedlings from the second planting still persist but are now seriously overtopped by the shrub layer, which has a three-growing-season lead. Pine seedlings from the first planting are scarce but are now safely above the shrub layer.

Pseudotsuga. For each seedling in each microsite, a regeneration efficiency (RE) value was computed. An RE value of 1.00 indicates that the seedlings occurred on a particular microsite in proportion to the occurrence of the microsite. Values greater than 3.01 are designated very efficient, 1.51 to 3.00 moderately efficient, 0.76 to 1.50 efficient, 0.26 to 0.76 inefficient, and less than 0.25 very inefficient. RE values were calculated for each microsite component (seedbed or cover).

Although RE values may reflect a relationship between the microsite and tree seedling, several factors affect interpretation of these values. It was assumed that seedlings persist only in favorable microsites; if a seed germinates in a favorable microsite which then deteriorates, such as through rapid shrub development, the seedling could die. Some seedlings may have been recorded in unfavorable microsites, but are still living. Therefore, some microsites identified as beneficial may in fact preclude development of tree seedlings. In this respect, the microsite canopy cover is more influential than the seedbed through time. The relationship between the microsite canopy cover and seedling was not always easy to determine. In some cases, the tree seedling and canopy cover may have benefited from the same microsite and simply established near one another coincidentally. In other cases, the tree seedling may have benefited from the existing cover, which provided more favorable microsite conditions in terms of shade, soil moisture and nutrients, humidity, temperature, and wind protection (Zavitskovski and Woodard 1970). Some microsites with cover vegetation may favor one seedling species but not another. A heavy canopy cover may favor shade-tolerant tree species but not shade-intolerant species, or an allelopathic cover species may deter establishment of some tree seedlings and not others. Where a positive seedling-microsite relationship exists, the canopy cover species may be used to help establish natural regeneration, or to indicate favorable microsites. Where a negative relationship exists, canopy cover species may indicate unfavorable microsites.

Pinus ponderosa regeneration is highest in group selection cuts (table 11). For silvicultural treatments (other than clearcuts) supporting *P. ponderosa* seedlings, the average distance to a *P. ponderosa* seed source was 25 feet (8 m). Treatments with no seedlings had an average distance to seed source of 91 feet (28 m). *Pinus ponderosa* seedling occurrence was only 2 percent in clearcuts, and the average distance to a seed source was 182 feet (55 m).

Most *P. ponderosa* seedlings (77 percent) occurred following light scarification due to logging activities or slash disposal (table 12). No seedlings were found on heavy scarification from contour terracing. Most seedlings occurred on bare mineral soil, which is a moderately efficient seedbed (table 13). No seedlings were found under heavy (67 to 100 percent) canopy cover, though the majority were under moderate (34 to 66 percent) canopy cover (table 14). *Symphoricarpos* and *Amelanchier* are very efficient covers for *P. ponderosa* seedlings; *Physocarpus* and *Ribes* are moderately efficient (table 15). Slash and *Ceanothus velutinus* are inefficient. Most seedlings (51 percent) estab-

lished in areas without a tree layer (table 16). In terms of shrub layer, most seedlings (83 percent) were found in the SASC layer group but not under the *Salix* (table 16).

On some sites, seed caches may play an important role in *P. ponderosa* establishment. In the Oregon Cascade Range, West (1968) found that 15 percent of the *P. ponderosa* seedlings resulted from rodent caches. In central Idaho, McConkie and Mowat (1936) reported 14 percent rodent-cached *P. ponderosa*. Medin (1984) indicated that the yellowpine chipmunk (*Eutamias amoenus*) may be responsible for many of the caches found in central Idaho, though Clark's nutcracker (*Nucifraga columbiana*) may also be involved (Lanner 1980). In the *Pseudotsuga menziesii*/*Carex geyeri* h.t., *Pinus ponderosa* phase, 22 percent of the *P. ponderosa* regeneration apparently established from seed caches (Steele and Geier-Hayes 1987a). The occurrence was similar in the *Pseudotsuga menziesii*/*Spiraea betulifolia* h.t. (16 percent) and *Abies grandis*/*Vaccinium globulare* and *Abies grandis*/*Acer glabrum* h.t.'s (both 17 percent) (Geier-Hayes 1987). But none of the *Pinus ponderosa* seedlings sampled in the PSME/PHMA h.t. apparently resulted from seed caches.

Group selection cuts, seed-tree cuts, or small 1- to 1½-acre (0.4- to 0.6-ha) clearcuts are probably the most effective treatment for establishment of *P. ponderosa* natural regeneration. Even though few natural seedlings were found on sampled clearcuts, many of these cuts were too large to provide adequate seed dispersal to the site. The average distance to a seed source for sampled clearcuts was 182 feet (55 m) (table 11) and researchers in central Idaho have found that most (82 percent) of the *P. ponderosa* seed falls within 100 feet (30 m) of the seed source (USDA FS 1940). Our survey substantiates this; all the *P. ponderosa* seedlings were found in cutting units where the average distance to a seed source was less than 100 feet (30 m) (table 11). Small strip clearcuts of 200 to 250 feet (61 to 76 m) wide (Foiles and Curtis 1973) or patch clearcuts should regenerate well if adequate seed sources are nearby. In all cases, 50 to 60 percent of the area should be scarified to remove the duff and expose mineral soil. Effective scarification treatments are those that produce the RICE or SASC layer group. Regeneration may also be adequate in scarified areas with high coverages of *Symphoricarpos* or *Amelanchier alnifolia* because both species are very effective covers for *P. ponderosa* seedlings.

Pseudotsuga menziesii regeneration is highest in group selection cuts (36 percent) and lowest in clearcuts (17 percent) (table 11). In cutting units with *Pseudotsuga* seedlings, the average distance to a seed source was 122 feet (37 m). For sites with no seedlings, the average distance to a *Pseudotsuga* seed source was 145 feet (44 m). Although many seedlings (31 percent) were found on unprepared sites (table 12), no seedlings were found on residual duff (table 13). Scarification treatments and broadcast burning are only slightly less effective than no site preparation. Moss mats are very efficient seedbeds for *Pseudotsuga* seedlings, and most moss mats were found on scarified soils. Litter-covered mineral soil and bare mineral soil were efficient and inefficient, respectively.

Table 11—Occurrence of natural tree seedlings (percent) by silvicultural method and percent overstory composition for the PSME/PHMA h.t., PIPO phase

Silvicultural method	Number of sites sampled ¹	Overstory cover ²	Distance to seed source ³	Seedling occurrence	
				PIPO	PSME
		Percent	Feet	----	Percent ----
CLEARCUT	15			2	17
Overstory					
<i>Pinus ponderosa</i>		0	182		
<i>Pseudotsuga menziesii</i>		0	136		
SEED-TREE CUT	3			15	20
Overstory				Breakdown of seedling occurrence by overstory composition	
<i>Pinus ponderosa</i>	2	8	33	100	100
<i>Pseudotsuga menziesii</i>		0	200		
<i>Pinus ponderosa</i>	1	1	150	-	-
<i>Pseudotsuga menziesii</i>		10	175		
SHELTERWOOD CUT	1			0	0
Overstory					
<i>Pinus ponderosa</i>	1	3	100		
<i>Pseudotsuga menziesii</i>		3	50		
SELECTION CUT	4			75	37
Overstory				Breakdown of seedling occurrence by overstory composition	
<i>Pinus ponderosa</i>	3	12	42	100	50
<i>Pseudotsuga menziesii</i>		1	87		
<i>Pseudotsuga menziesii</i>	1	15	40	-	50
STAND-DESTROYING WILDFIRE	3			8	26
Overstory				Breakdown of seedling occurrence by overstory composition	
<i>Pinus ponderosa</i>	1	0	200	-	15
<i>Pseudotsuga menziesii</i>		0	150		
<i>Pinus ponderosa</i>		3	0	100	77
<i>Pseudotsuga menziesii</i>		3	0		
<i>Pinus ponderosa</i>		0	70	-	8
<i>Pseudotsuga menziesii</i>		3	0		

¹Each site contained five sampled microplots.

²Percent canopy cover of trees >4 inches d.b.h.

³Distance from center of 375-m² plot to seed source; immature trees often comprised overstory composition.

⁴Seed source on plot.

Table 12—Occurrence of natural tree seedlings (percent) by site preparation method for the PSME/PHMA h.t., PIPO phase

Species	Site preparation				
	None	Broadcast burn	Wildfire	Scarification	
				Light	Heavy
				----- Percent -----	
<i>Pinus ponderosa</i>	0	13	10	77	0
<i>Pseudotsuga menziesii</i>	31	23	18	12	16
				----- Number -----	
Sites ¹	3	7	4	8	4

¹Each site contained five sampled microplots.

Table 13—Occurrence of natural tree seedlings (percent) by seedbed with regeneration efficiencies (RE)¹ of seedbeds for the PSME/PHMA h.t., PIPO phase

Species	Seedbed											
	Litter-covered scarified		Bare mineral soil		Moss mat		Rotten wood		Residual duff		Rocks or stumps	
	Pct	RE	Pct	RE	Pct	RE	Pct	RE	Pct	RE	Pct	RE
<i>Pinus ponderosa</i>	39	0.75	61	1.62	—	—	—	—	—	—	—	—
<i>Pseudotsuga menziesii</i>	43	1.09	10	.34	47	4.70	—	—	—	—	—	—
Seedbed occurrence ²	55		36		6		1		1		1	

¹Regeneration efficiency is the percent occurrence of each seedling species divided by the percent area occupied by the seedbed.

²Percent occurrence of seedbed in all microplots.

Table 14—Occurrence of natural tree seedlings (percent) by shrub canopy cover for the PSME/PHMA h.t., PIPO phase

Species	Shrub canopy cover		
	Light (0-33%)	Moderate (33-66%)	Heavy (66-100%)
----- Percent -----			
<i>Pinus ponderosa</i>	34	66	0
<i>Pseudotsuga menziesii</i>	23	58	19
----- Number -----			
Microplots	48	35	32

Table 15—Regeneration efficiency (RE)¹ values of shrub canopies and other microsites for tree seedlings in the PSME/PHMA h.t., PIPO phase

Canopy	Canopy constancy	Area occupied	<i>Pinus ponderosa</i>	<i>Pseudotsuga menziesii</i>
----- Percent -----			RE	RE
None ²	-	-	-	-
Forbs	98	21		0.27
<i>Ceanothus velutinus</i>	45	14	0.42	1.85
Grasses and sedges	86	11		.40
<i>Physocarpus malvaceus</i>	69	11	1.64	2.42
Slash	72	10	.60	.70
<i>Spiraea betulifolia</i>	66	8		1.33
<i>Pinus ponderosa</i>	31	5	1.29	.50
<i>Prunus</i> spp.	34	4		
<i>Salix scouleriana</i>	15	3		1.36
<i>Symphoricarpos</i> spp.	39	3	3.96	
<i>Rosa</i> spp.	21	3		
<i>Amelanchier alnifolia</i>	23	2	6.09	1.77
<i>Ribes</i> spp.	15	2	2.68	.52
<i>Berberis repens</i>	22	1		
<i>Sorbus scopulina</i>	4	1		
<i>Sambucus</i> spp.	9	1		
<i>Populus tremuloides</i>	7	1		
<i>Vaccinium globulare</i>	1	<1		
<i>Lonicera utahensis</i>	4	<1		
<i>Pseudotsuga menziesii</i>	2	<1		
<i>Acer glabrum</i>	4	<1		
<i>Chrysothamnus nauseosus</i>	2	<1		
<i>Rubus parviflorus</i>	1	<1		

¹Regeneration efficiency is the percent occurrence of the seedling species divided by the percent area occupied by the cover. No entry indicates that no seedlings were found.

²During sampling, no estimate of "none" type of cover was made for each plot; therefore, no RE value could be calculated. However, 35 percent of the *Pinus ponderosa* and 9 percent of the *Pseudotsuga menziesii* seedlings were found under no cover.

Table 16—Occurrence of natural tree seedlings (percent) by tree and shrub layer groups in the PSME/PHMA h.t., PIPO phase

Layer group	Number of sites ¹	Seedling species	
		PIPO	PSME
----- <i>Percent</i> -----			
TREE LAYER GROUPS			
depauperate	16	51	20
POTR	2	29	6
PIPO	6	20	20
PSME	2	-	54
SHRUB LAYER GROUPS			
depauperate	2	-	2
CEVE	11	1	12
RICE	2	13	26
SASC	2	83	28
PREM	5	3	5
AMAL	1	-	19
SPBE	1	-	-
PHMA	2	-	8

¹Each site contained five sampled microplots.

Many of the *Pseudotsuga* seedlings (58 percent) were found in moderate shade (table 14). *Ceanothus* spp., *Amelanchier*, and *Physocarpus* were moderately efficient covers (table 15). Slash, *Ribes* spp., forbs, and grasses and sedges were inefficient. *Salix* and *Spiraea* were both efficient.

In terms of tree layer groups, most seedlings (54 percent) were found in the PSME layer group (table 16). In the shrub layers, many *Pseudotsuga* seedlings (28 percent) were found in the SASC layer group, followed by the RICE layer group (26 percent). Depauperate shrub layers resulted in the fewest seedlings (2 percent).

Small group selection cuts or small strip or patch clearcuts that have been scarified to produce the SASC or RICE layer groups or burned to produce the CEVE layer group should regenerate natural *Pseudotsuga* in the PSME/PHMA h.t. In the RICE layer group, however, continuous cover of *Ribes* may preclude *Pseudotsuga* establishment because *Ribes* is an inefficient cover for *Pseudotsuga*. In this case, layer types other than RICE-RICE, such as RICE-AMAL or RICE-PHMA, should regenerate

well because both *Amelanchier alnifolia* and *Physocarpus* are moderately efficient covers for *Pseudotsuga*.

The Herb Layer

The herb layer is the most complex and least understood of the three vegetation layers. Modal conditions of seral stages are evident but more variable because there are more species. More species imply potentially more herb layer types, but the relative increase has been less than expected. It is possible that more kinds of disturbance are needed to generate the potentially broad array of layer types. Still, the following herb layer classification appears to follow logical successional sequences even though it may eventually need more refinement than the tree or shrub layer classification.

Table 17 lists the major herb layer species, which were those that showed greater than 5 percent cover somewhere in the data. Many unlisted species may be present in lesser amounts, and some potentially important species may yet be found. Relative successional amplitudes were

Table 17—Successional roles of major herb layer species in the PSME/PHMA h.t., PIPO phase

ADP No.	Herb layer species	Abbreviation	Role ^a
Perennial graminoids			
303	<i>Bromus carinatus</i>	BRCA	(ES)
282	<i>Bromus inermis</i>	BRIN	ES
317	<i>Calamagrostis rubescens</i>	CARU	(C)
309	<i>Carex geyeri</i>	CAGE	LS
331	<i>Poa nervosa</i>	PONE	LS
Perennial herbs			
566	<i>Agastache urticifolia</i>	AGUR	(ES)
415	<i>Apocynum androsaemifolium</i>	APAN	MS
413	<i>Antennaria racemosa</i>	ANRA	(LS)
420	<i>Arenaria macrophylla</i>	ARMA	LS
421	<i>Arnica cordifolia</i>	ARCO	C
426	<i>Aster conspicuus</i>	ASCO	LS
431	<i>Balsamorhiza sagittata</i>	BASA	(ES)
438	<i>Castilleja miniata</i>	CAMI	MS
459	<i>Epilobium angustifolium</i>	EPAN	(MS)
465	<i>Fragaria vesca</i>	FRVE	MS
466	<i>Fragaria virginiana</i>	FRVI	(MS)
471	<i>Galium triflorum</i>	GATR	LS
473	<i>Geranium viscosissimum</i>	GEVI	ES
833	<i>Iliamna rivularis</i>	ILRI	ES
636	<i>Lathyrus nevadensis</i>	LANE	(C)
658	<i>Penstemon attenuatus</i>	PEAT	(MS)
514	<i>Penstemon wilcoxii</i>	PEWI	LS
522	<i>Potentilla glandulosa</i>	POGL	ES
675	<i>Rudbeckia occidentalis</i>	RUOC	ES
547	<i>Thalictrum occidentale</i>	THOC	(C)
691	<i>Veratrum californicum</i>	VECA	MS

^aES = Early seral

MS = Mid-seral

LS = Late seral to climax

C = Climax

() = Occurs in only part of the PIPO phase

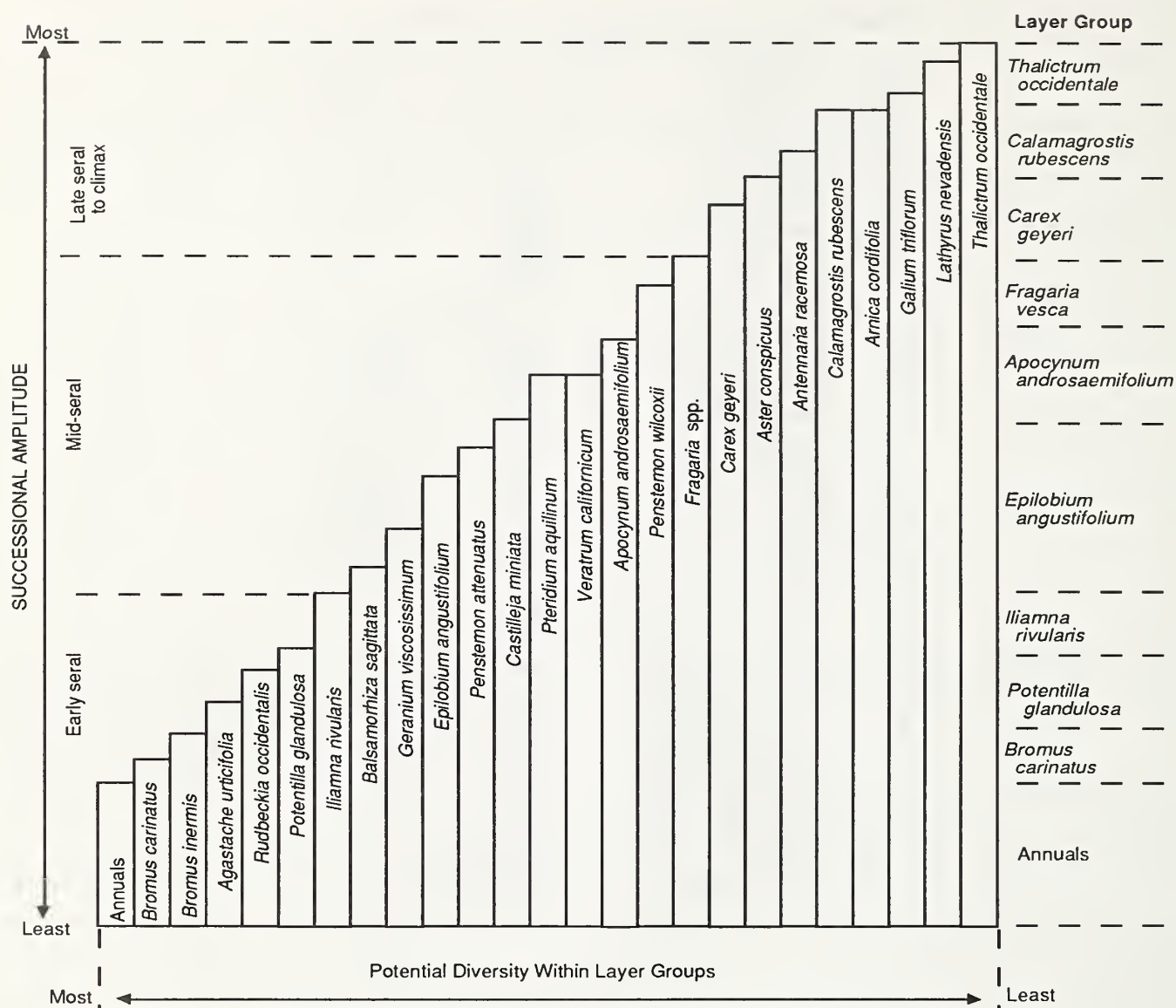


Figure 14—Relative successional amplitudes of important herb layer species in the PSME/PHMA h.t., PIPO phase.

derived for important herb layer species (fig. 14). This was accomplished by developing hypotheses for each species, then by testing each hypothesis through field observation and data analysis. Because succession in the herb layer progresses more rapidly than the tree or shrub layer, successional amplitudes for some herb layer species can also be derived from the permanent plot records of Stickney (1980, 1985). As in the tree and shrub layer, successional amplitudes of herb layer species are meaningful only in a relative sense, and the greatest accuracy lies with those amplitudes that are farthest apart. For instance, species indicating the Annuals layer group clearly have less amplitude than *Thalictrum* (fig. 14). But there is less certainty to the relative amplitudes of adjacent species such as *Fragaria* versus *Carex geyeri*.

The relative successional amplitudes in figure 14 provide a basis for the present herb layer classification (fig. 15). This classification consists of 10 layer groups; the full data set appears in appendix C. Although the classification is based on 100 sample plots, some layer groups have little data. The Annuals layer group are weakly represented because these species often occur within 5 years following disturbance and such sites were not heavily sampled. Other layer types may be found with more reconnaissance, may appear only after uncommon disturbances, or may be rare under any circumstance.

The key to herb layer types (table 18) contains numerous alternate indicator species. Much of this lumping is necessary to maintain a workable number of units in this diverse vegetative layer. In some cases, combining

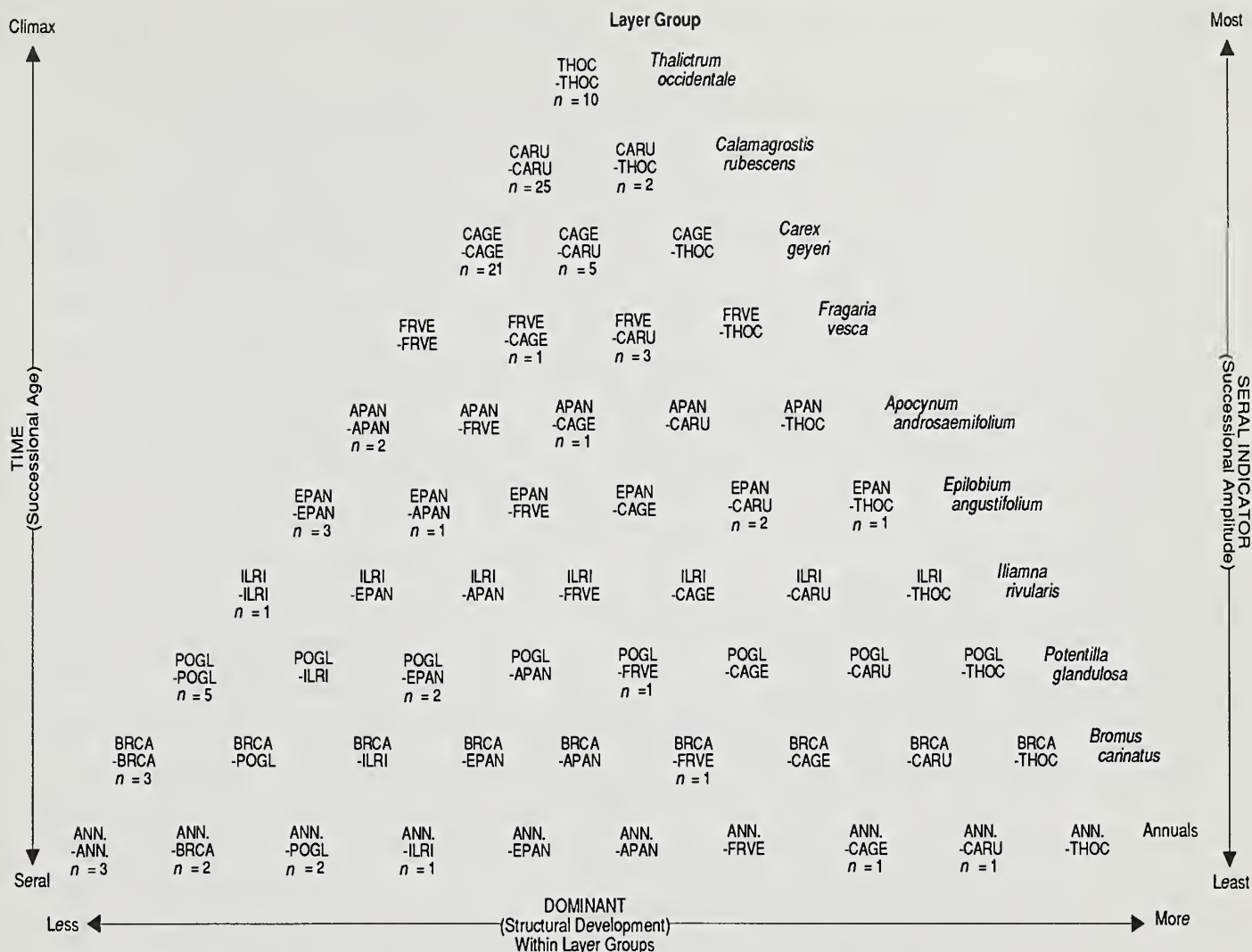


Figure 15—Succession classification diagram of the herbaceous layer in the PSME/PHMA h.t., PIPO phase (n = number of samples in each layer type).

indicator species has reduced uniformity within the unit because the species represent minor differences of environment or successional pattern within the habitat type. In other cases, the alternate indicators are common environmental and successional equivalents, and the classified unit retains substantial uniformity. In all cases the lumped species appear to have similar successional amplitudes (fig. 14).

Early seral annuals, biennials, and short-lived perennials were grouped into one unit because there appears to be no practical reason to recognize them individually. *Rudbeckia* and *Agastache* were grouped with *Potentilla* because of similar responses to scarification. *Balsam-*

orhiza, *Geranium*, and *Penstemon attenuatus* were occasionally well represented near the dry extreme of PSME/PHMA and were grouped with *Epilobium* as indicators of mid-seral conditions. *Castilleja* from the moist extremes of the habitat type was also grouped with *Epilobium* for this reason. *Pteridium* and *Veratrum* were each well represented in only one sample plot and were subjectively grouped with *Apocynum* as mid-seral indicators. *Carex geyeri* and *Aster conspicuus* were combined as late seral indicators; *Arnica cordifolia*, *Antennaria racemosa*, and *Galium triflorum* were grouped with *Calamagrostis rubescens* as near-climax indicators. *Lathyrus nevadensis* was grouped with *Thalictrum* as a climax associate.

Table 18—Key to herb layer groups and layer types, with ADP codes, in the PSME/PHMA h.t., PIPO phase

		ADP codes
1.	Annuals, biennials, and short-lived perennials (see layer group description for species) well represented ($\geq 5\%$) ¹ either individually or collectively ANNUALS Layer Group	900
	(Choose first condition that fits)	
1a.	The above species dominant?..... ANN.-ANN. Layer Type	900.900
1b.	<i>Bromus carinatus</i> (incl. <i>Bromus inermis</i> and <i>Agropyron intermedium</i>) dominant or codominant ³ ANN.-BRCA Layer Type	900.303
1c.	<i>Potentilla glandulosa</i> (incl. <i>Agastache</i> and <i>Rudbeckia</i>) dominant or codominant ANN.-POGL Layer Type	900.522
1d.	<i>Iliamna</i> dominant or codominant ANN.-ILRI Layer Type	900.833
1e.	<i>Epilobium angustifolium</i> (incl. <i>Balsamorhiza</i> , <i>Geranium</i> , <i>Castilleja</i> , and <i>Penstemon attenuatus</i>) dominant or codominant ANN.-EPAN Layer Type	900.459
1f.	<i>Apocynum androsaemifolium</i> (incl. <i>Pteridium</i> and <i>Veratrum</i>) dominant or codominant ANN.-APAN Layer Type	900.415
1g.	<i>Fragaria vesca</i> (incl. <i>F. virginiana</i> and <i>Penstemon wilcoxii</i>) dominant or codominant ANN.-FRVE Layer Type	900.465
1h.	<i>Carex geyeri</i> (incl. <i>Aster conspicuus</i>) dominant or codominant ANN.-CAGE Layer Type	900.309
1i.	<i>Calamagrostis rubescens</i> (incl. <i>Arnica</i> , <i>Antennaria racemosa</i> , and <i>Galium triflorum</i>) dominant or codominant ANN.-CARU Layer Type	900.307
1j.	<i>Thalictrum occidentale</i> (incl. <i>Lathyrus nevadensis</i>) dominant or codominant ANN.-THOC Layer Type	900.547
1.	Annuals, biennials, and short-lived perennials poorly represented ($< 5\%$) 2	
2.	<i>Bromus carinatus</i> (incl. <i>Bromus inermis</i> and <i>Agropyron intermedium</i>) well represented ($\geq 5\%$) BRCA Layer Group	303
	(Choose first condition that fits)	
2a.	The above species dominant BRCA-BRCA Layer Type	303.303
2b.	<i>Potentilla glandulosa</i> (incl. <i>Agastache</i> and <i>Rudbeckia</i>) dominant or codominant BRCA-POGL Layer Type	303.522
2c.	<i>Iliamna</i> dominant or codominant BRCA-ILRI Layer Type	303.833
2d.	<i>Epilobium angustifolium</i> (incl. <i>Balsamorhiza</i> , <i>Geranium</i> , <i>Castilleja</i> , and <i>Penstemon attenuatus</i>) dominant or codominant BRCA-EPAN Layer Type	303.459
2e.	<i>Apocynum androsaemifolium</i> (incl. <i>Pteridium</i> and <i>Veratrum</i>) dominant or codominant BRCA-APAN Layer Type	303.415
2f.	<i>Fragaria vesca</i> (incl. <i>F. virginiana</i> and <i>Penstemon wilcoxii</i>) dominant or codominant BRCA-FRVE Layer Type	303.465
2g.	<i>Carex geyeri</i> (incl. <i>Aster conspicuus</i>) dominant or codominant BRCA-CAGE Layer Type	303.309
2h.	<i>Calamagrostis rubescens</i> (incl. <i>Arnica</i> , <i>Antennaria racemosa</i> , and <i>Galium triflorum</i>) dominant or codominant BRCA-CARU Layer Type	303.307
2i.	<i>Thalictrum occidentale</i> (incl. <i>Lathyrus nevadensis</i>) dominant or codominant BRCA-THOC Layer Type	303.547
2.	<i>Bromus</i> spp. poorly represented ($< 5\%$) 3	
3.	<i>Potentilla glandulosa</i> (incl. <i>Agastache</i> and <i>Rudbeckia</i>) well represented ($\geq 5\%$) POGL Layer Group	522
	(Choose first condition that fits)	
3a.	The above species dominant POGL-POGL Layer Type	522.522
3b.	<i>Iliamna</i> dominant or codominant POGL-ILRI Layer Type	522.833
3c.	<i>Epilobium angustifolium</i> (incl. <i>Balsamorhiza</i> , <i>Geranium</i> , <i>Castilleja</i> , and <i>Penstemon attenuatus</i>) dominant and codominant POGL-EPAN Layer Type	522.459
3d.	<i>Apocynum androsaemifolium</i> (incl. <i>Pteridium</i> and <i>Veratrum</i>) dominant or codominant POGL-APAN Layer Type	522.415
3e.	<i>Fragaria vesca</i> (incl. <i>F. virginiana</i> and <i>Penstemon wilcoxii</i>) dominant or codominant POGL-FRVE Layer Type	522.465
3f.	<i>Carex geyeri</i> (incl. <i>Aster conspicuus</i>) dominant or codominant POGL-CAGE Layer Type	522.309
3g.	<i>Calamagrostis rubescens</i> (incl. <i>Arnica</i> , <i>Antennaria racemosa</i> , and <i>Galium triflorum</i>) dominant or codominant POGL-CARU Layer Type	522.307
3h.	<i>Thalictrum occidentale</i> (incl. <i>Lathyrus nevadensis</i>) dominant or codominant POGL-THOC Layer Type	522.547
3.	<i>Potentilla</i> (incl. <i>Agastache</i> and <i>Rudbeckia</i>) poorly represented ($< 5\%$) 4	
4.	<i>Iliamna rivularis</i> well represented ($\geq 5\%$) ILRI Layer Group	833
	(Choose first condition that fits)	
4a.	<i>Iliamna</i> dominant ILRI-ILRI Layer Type	833.833
4b.	<i>Epilobium angustifolium</i> (incl. <i>Balsamorhiza</i> , <i>Geranium</i> , <i>Castilleja</i> , and <i>Penstemon attenuatus</i>) dominant or codominant ILRI-EPAN Layer Type	833.459
4c.	<i>Apocynum androsaemifolium</i> (incl. <i>Pteridium</i> and <i>Veratrum</i>) dominant or codominant ILRI-APAN Layer Type	833.415
4d.	<i>Fragaria vesca</i> (incl. <i>F. virginiana</i> and <i>Penstemon wilcoxii</i>) dominant or codominant ILRI-FRVE Layer Type	833.465

(con.)

Table 18 (Con.)

		ADP codes
4e.	<i>Carex geyeri</i> (incl. <i>Aster conspicuus</i>) dominant or codominant	ILRI-CAGE Layer Type 833.309
4f.	<i>Calamagrostis rubescens</i> (incl. <i>Arnica</i> , <i>Antennaria racemosa</i> , and <i>Galium triflorum</i>) dominant or codominant	ILRI-CARU Layer Type 833.307
4g.	<i>Thalictrum occidentale</i> (incl. <i>Lathyrus nevadensis</i>) dominant or codominant	ILRI-THOC Layer Type 833.547
4.	<i>Iliamna</i> poorly represented (<5%)	5
5.	<i>Epilobium angustifolium</i> (incl. <i>Balsamorhiza</i> , <i>Geranium</i> , <i>Castilleja</i> , and <i>Penstemon attenuatus</i>) well represented (≥5%)	EPAN Layer Group 459
	(Choose first condition that fits)	
5a.	The above species dominant	EPAN-EPAN Layer Type 459.459
5b.	<i>Apocynum androsaemifolium</i> (incl. <i>Pteridium</i> and <i>Veratrum</i>) dominant or codominant	EPAN-APAN Layer Type 459.415
5c.	<i>Fragaria vesca</i> (incl. <i>F. virginiana</i> and <i>Penstemon wilcoxii</i>) dominant or codominant	EPAN-FRVE Layer Type 459.465
5d.	<i>Carex geyeri</i> (incl. <i>Aster conspicuus</i>) dominant or codominant	EPAN-CAGE Layer Type 459.309
5e.	<i>Calamagrostis rubescens</i> (incl. <i>Arnica</i> , <i>Antennaria racemosa</i> , and <i>Galium triflorum</i>) dominant or codominant	EPAN-CARU Layer Type 459.307
5f.	<i>Thalictrum occidentale</i> (incl. <i>Lathyrus nevadensis</i>) dominant or codominant	EPAN-THOC Layer Type 459.547
5.	<i>Epilobium</i> (incl. <i>Balsamorhiza</i> , <i>Geranium</i> , <i>Castilleja</i> , and <i>Penstemon</i> <i>attenuatus</i>) poorly represented (<5%)	6
6.	<i>Apocynum androsaemifolium</i> (incl. <i>Pteridium</i> and <i>Veratrum</i>) well represented (≥5%)	APAN Layer Group 415
	(Choose first condition that fits)	
6a.	The above species dominant	APAN-APAN Layer Type 415.415
6b.	<i>Fragaria vesca</i> (incl. <i>F. virginiana</i> and <i>Penstemon wilcoxii</i>) dominant or codominant	APAN-FRVE Layer Type 415.465
6c.	<i>Carex geyeri</i> (incl. <i>Aster conspicuus</i>) dominant or codominant	APAN-CAGE Layer Type 415.309
6d.	<i>Calamagrostis rubescens</i> (incl. <i>Arnica</i> , <i>Antennaria racemosa</i> , and <i>Galium triflorum</i>) dominant or codominant	APAN-CARU Layer Type 415.307
6e.	<i>Thalictrum occidentale</i> (incl. <i>Lathyrus nevadensis</i>) dominant or codominant	APAN-THOC Layer Type 415.547
6.	<i>Apocynum</i> (incl. <i>Pteridium</i> and <i>Veratrum</i>) poorly represented (5%)	7
7.	<i>Fragaria vesca</i> (incl. <i>F. virginiana</i> and <i>Penstemon wilcoxii</i>) well represented (≥5%)	FRVE Layer Group 465
	(Choose first conditions that fits)	
7a.	The above species dominant	FRVE-FRVE Layer Type 465.465
7b.	<i>Carex geyeri</i> (incl. <i>Aster conspicuus</i>) dominant or codominant	FRVE-CAGE Layer Type 465.309
7c.	<i>Calamagrostis rubescens</i> (incl. <i>Arnica</i> , <i>Antennaria racemosa</i> , and <i>Galium triflorum</i>) dominant or codominant	FRVE-CARU Layer Type 465.307
7d.	<i>Thalictrum occidentale</i> (incl. <i>Lathyrus nevadensis</i>) dominant or codominant	FRVE-THOC Layer Type 465.547
7.	<i>Fragaria</i> spp. and <i>Penstemon</i> poorly represented (<5%)	8
8.	<i>Carex geyeri</i> (incl. <i>Aster conspicuus</i>) well represented (≥5%)	CAGE Layer Group 309
8a.	The above species dominant	CAGE-CAGE Layer Type 309.309
8b.	<i>Calamagrostis rubescens</i> (incl. <i>Arnica</i> , <i>Antennaria racemosa</i> , and <i>Galium triflorum</i>) dominant or codominant	CAGE-CARU Layer Type 309.307
8c.	<i>Thalictrum occidentale</i> (incl. <i>Lathyrus nevadensis</i>) dominant or codominant	CAGE-THOC Layer Type 309.547
8.	<i>Carex</i> and <i>Aster</i> poorly represented (<5%)	9
9.	<i>Calamagrostis rubescens</i> (incl. <i>Arnica</i> , <i>Antennaria racemosa</i> , and <i>Galium triflorum</i>) well represented (≥5%)	CARU Layer Group 307
	(Choose first condition that fits)	
9a.	The above species dominant	CARU-CARU Layer Type 307.307
9b.	<i>Thalictrum occidentale</i> (incl. <i>Lathyrus nevadensis</i>) dominant or codominant	CARU-THOC Layer Type 307.547
9.	<i>Calamagrostis</i> (incl. <i>Arnica</i> , <i>Antennaria</i> , and <i>Galium</i>) poorly represented (<5%)	10
10.	<i>Thalictrum occidentale</i> (incl. <i>Lathyrus nevadensis</i>) well represented (≥5%)	THOC Layer Group 547
10a.	The above species dominant	THOC-THOC Layer Type 547.547
10.	<i>Thalictrum</i> (incl. <i>Lathyrus</i>) poorly represented (<5%)	depauperate or unclassified layer type

¹"Well represented" means canopy cover ≥5 percent.

²"Dominant" means greatest canopy cover.

³"Codominant" means canopy cover is nearly equal to that of another herb layer species.

ANNUALS LAYER GROUP (ANN. L.G.)

Annuals, mainly species of *Descurainia*, *Epilobium*, *Galium*, and *Gayophytum* and occasionally *Cryptantha*, can develop high coverages on newly exposed soil in full sunlight. These taxa have little competitive ability and their annual nature makes them vulnerable to replacement by any perennial. Likewise, biennials such as *Lactuca*, *Verbascum*, and *Cirsium vulgare* and the short-lived perennials *Phacelia* and *Gnaphalium* must reestablish frequently in order to maintain high coverages. Without recurring disturbance these taxa are also easily replaced as succession advances. Relative amounts of these early seral colonizers vary considerably following disturbance and appear to be mainly a function of available seed rather than the type of disturbance. The Annuals layer group represents the earliest seral conditions of the herb layer and is usually replaced within the first 5 years following disturbance; however, it can be maintained by intense livestock use.

Although not a sampling objective, Annuals layer types were frequently encountered in PSME/PHMA. Six out of the 10 possible layer types were sampled (fig. 15). Most of these resulted from clearcutting and scarification. The ANN.-ILRI and ANN.-CARU layer types resulted from clearcutting and broadcast burning; the other four resulted from clearcutting and scarification. In a few cases these layer types were surprisingly persistent, even where no grazing had occurred. An ANN.-BRCA layer type occurred on one site 15 years after the scarification, and an ANN.-CAGE layer type was present 17 years following site treatment.

BROMUS CARINATUS LAYER GROUP (BRCA L.G.)

Bromus carinatus is a nonrhizomatous grass that has little tolerance for shade and decreases under grazing, mainly from cattle. Occasionally, it develops high coverages in early seral stages either from direct seeding or natural colonization. In both cases, however, the sites receive little or no grazing. *Bromus inermis* is a rhizomatous grass that usually results from direct seeding. It too can develop high coverages on ungrazed sites. Like most grasses, these bromes store little or no seed in the soil (Kramer 1984; Strickler and Edgerton 1976). Both species can be used as indicators of this layer group. *Agropyron intermedium* can also achieve high coverages in PSME/PHMA from direct seeding and should be included in the BRCA layer group.

The BRCA layer group is not common in PSME/PHMA; only two of the nine possible layer types were found (fig. 15). In most if not all cases, these layer types resulted from direct seeding following wildfire (fig. 16) or scarification 5 to 13 years ago. None of these sites were being grazed. High coverages of seeded grasses are effective soil stabilizers following disturbance but can preclude establishment of other species including trees. Where high coverages of *Calamagrostis rubescens* exist prior to burning, the seeding of grasses may be unnecessary (Crane and others 1983).

POTENTILLA GLANDULOSA LAYER GROUP (POGL L.G.)

The perennial forb *Potentilla glandulosa* is nonrhizomatous and intolerant of shade. In full sunlight, it flowers



Figure 16—A BRCA-BRCA herb layer type east of Lowman, ID. This herb layer type was created by seeding the area following a wildfire 7 years ago. *Bromus inermis* and *Agropyron intermedium* now dominate the herb layer. *Iliamna* is the only other herbaceous species present in more than trace amounts. This herb layer type often precludes tree regeneration.

readily and produces large numbers of seed that store in the soil (Kramer 1984). The seeds often germinate profusely following scarification, which can result from either mechanical treatment of the site or heavy livestock use. This species of *Potentilla* seems to be less palatable to livestock than most associated herbs and can increase under grazing to the point of being the only species that is well represented on the site.

Agastache urticifolia is a nonrhizomatous, shade-intolerant forb, with seed that can be stored in the soil (Kramer 1984). It occasionally develops high coverages following scarification and appears to be a successional equivalent of *Potentilla*. Therefore, it is included as an alternate indicator of this layer group.

Rudbeckia occidentalis is a nonrhizomatous perennial with successional responses similar to those of *Potentilla*. One difference, however, is that *Rudbeckia* tends to be a more successful invader on basaltic soils than on granitics, whereas *Potentilla* is successful on both granitic and basaltic soils. Both soil types are common in PSME/PHMA.

Three of the eight possible layer types were found (fig. 15). These layer types represent early seral stages of herb layer succession and are mainly the result of scarification without burning. The POGL-FRVE layer type occurred on a site that had been broadcast burned and scarified. Initially, it may have been an ILRI layer type, but because of heavy grazing by sheep, only a trace of *Iliamna* was present. It is not uncommon for POGL layer types to

result from grazing disturbance on sites that had been previously logged. Most sample stands in this layer group were disturbed less than 18 years ago (appendix C). These layer types will only persist until a shrub layer begins to shade the site.

ILIAMNA RIVULARIS LAYER GROUP (ILRI L.G.)

Iliamna rivularis is a nonrhizomatous early seral perennial. In full sun, it can flower profusely and produce seed that store in the soil for long periods (Kramer 1984). This species can become well represented following clearcutting and hot broadcast burning or where slash has been piled and burned (fig. 17). It may also appear following high-intensity wildfire. This response is common in other habitat types such as Douglas-fir/mountain maple (PSME/ACGL) but is currently rare in PSME/PHMA.

ILRI layer types were rarely found in PSME/PHMA (fig. 15) even though small amounts of *Iliamna* were often present in early seral herb layers. It appears that ILRI layer types could become more common on PSME/PHMA sites if high-intensity wildfires and broadcast burns occurred more often and allowed *Iliamna* to increase its coverage and seed with each disturbance. However, Kramer (1984) found no *Iliamna* seed in the 16 old-growth stands of PSME/PHMA that he sampled. Thus some stands do not have the potential at present to produce ILRI layer types from intense burning. It is not known whether this is due to unfavorable environment or site history.



Figure 17—An ILRI-ILRI herb layer type north of Bogus Basin Ski Area. This area was clearcut and severely burned 2 years ago. *Iliamna* germinated profusely from seed buried in the soil and now dominates the site. In a few years the *Iliamna* will give way to a CEVE-CEVE shrub layer.

EPILOBIUM ANGUSTIFOLIUM LAYER GROUP (EPAN L.G.)

Epilobium angustifolium is a rhizomatous perennial that can establish readily from windblown seed. In open areas created by stand-destroying wildfire, it characteristically colonizes bare soil and forms extensive colonies that bloom profusely (Stickney 1985). *Epilobium*, however, does not always need burned areas for establishment. In clearcuts, it often appears on burned or unburned dozer-piled debris, where soil and debris have been mixed. Apparently the required substrate for *Epilobium* is deep, loose soil, usually exposed by either fire or logging.

Geranium viscosissimum is a nonrhizomatous forb that has some tolerance for light shade. It apparently increases when grazing, especially by sheep, has been reduced. At the dry extremes of PSME/PHMA, it occasionally becomes a notable component of ungrazed forb communities in mid-seral condition. Apparently *G. viscosissimum* has limited ability to store its seed in the soil and duff (Kramer 1984).

Balsamorhiza sagittata is a deep-rooted, nonrhizomatous forb that has some tolerance for light shade. Occasionally it becomes well represented in early- to mid-seral stages at the driest extremes of PSME/PHMA succession. Like *Geranium*, *Balsamorhiza* has only limited ability to store its seed in the soil and duff (Krygier 1955) and is considered to be successional equivalent to *Geranium*. Because neither *Geranium* nor *Balsamorhiza* become well represented in most of the PSME/PHMA habitat type, they were subjectively grouped with *Epilobium*.

Castilleja miniata is a woody-based forb with some tolerance for light shade and grazing. In PSME/PHMA, it occasionally develops relatively high coverages in stands of patchy timber or scattered tall shrubs. In the Weiser River drainage, *Castilleja applegatei* may also be present on these sites and is considered a successional equivalent of *C. miniata*. Because of their sparse occurrence in PSME/PHMA, these *Castillejas* were subjectively grouped with *Epilobium* as indicators of mid-seral herb layers.

Penstemon attenuatus is a woody based perennial that forms small mats from a rhizome-caudex. It can apparently increase under light shade and light grazing but requires bare soil for establishment. Occasionally it becomes well represented on scarified sites in PSME/PHMA.

The EPAN layer group is fairly common in PSME/PHMA; four of the six possible layer types were found (fig. 15). About half of the sample plots in this layer group resulted from wildfire or broadcast burning, 6 to 55 years ago (fig. 18); the remainder resulted from scarification 8 to 15 years ago. Only one sample stand was receiving moderate grazing by sheep; the rest were receiving little or no grazing.

APOCYNUM ANDROSAEMIFOLIUM LAYER GROUP (APAN L.G.)

Apocynum is a rhizomatous forb that can develop a substantial coverage in full sun or partial shade. It is highly unpalatable to livestock and can withstand light to moderate grazing impacts. There is no indication that *Apocynum* seed will store in the soil (Kramer 1984).



Figure 18—An EPAN-EPAN herb layer type northeast of New Centerville, ID. This site was burned 6 years ago by a wildfire of moderate intensity. *Epilobium angustifolium* is the only herb layer species that is well represented. Soon it will be over-topped by *Ceanothus*.

Veratrum californicum is a tall rhizomatous forb that can maintain substantial coverages beneath partial shade. Like *Apocynum*, it has low palatability to livestock and can withstand considerable grazing impact. Black bear, however, will eat the thick shoots, especially in late spring. *Veratrum*'s seed storage capability remains unknown. Occasionally it becomes well represented in PSME/PHMA and is considered an alternate indicator of the APAN layer group.

Pteridium is a rhizomatous fern capable of developing extensive colonies, especially with repeated burning. It can dominate forest openings for many decades, even without burning, and often maintains relatively pure stands. This latter trait has implicated *Pteridium* with allelopathic capability, a feature substantiated by Stewart (1975), Horsley (1977), and del Moral and Cates (1971). Apparently the senescent fronds produce the greatest inhibitory effects on certain herbaceous and woody vegetation. Recently, *Pteridium* has been shown to substantially inhibit conifers (Ferguson and Boyd 1988). Although it often grows vigorously in full sun, *Pteridium* can also increase under light shade but declines under a mature coniferous canopy. Although *Pteridium* occurs sporadically in PSME/PHMA, it was well represented in only one sample stand and so was grouped with *Apocynum* as an indicator of mid-seral herb layers.

The APAN layer group was not common in PSME/PHMA; only two of the five possible layer types were found. The sampled plots had been either burned by wildfire or scarified 18 to 50 years ago. It is likely that the APAN layer types are the result of successional advance rather than a direct response to disturbance. They may, however, develop directly from the Annuals layer group (ANN.-APAN) because both *Apocynum* and *Pteridium* can survive scarification and burning.

FRAGARIA VESCA LAYER GROUP (FRVE L.G.)

Fragaria vesca and *F. virginiana* can develop substantial coverages through their stoloniferous growth habit. This happens most frequently beneath a light canopy of trees or tall shrubs where partial shade has reduced competition from early seral herbs. Trampling from grazing animals can reduce the coverage of *Fragaria*, especially *F. vesca*. On the cutover sites that are being heavily grazed, *Fragaria* often achieves notable development beneath the protection of large shrubs, such as *Salix*, while the shrub interspaces contain mostly *Potentilla* and other species more tolerant of grazing. Although both species of *Fragaria* occur in PSME/PHMA, *F. vesca* is the most common. Kramer (1984) found small amounts of viable *Fragaria* seed stored in the soil, but birds and mammals likely disperse most of the seed. Apparently *Fragaria* needs bare shaded soil for seedling establishment.

Penstemon wilcoxii is a moderately shade-tolerant perennial that occasionally becomes well represented in PSME/PHMA. Like *Fragaria*, it too has small amounts of viable seed stored in the soil (Kramer 1984) and germinates well on bare, shaded soil. For classification purposes, *P. wilcoxii* was arbitrarily grouped with *Fragaria* as an alternate indicator of late mid-seral herb layers. But *P. wilcoxii* (with toothed leaves) must be dis-

tinguished from the less tolerant *P. attenuatus* (with entire leaves), which was grouped with *Epilobium*.

The FRVE layer group represents a mid-seral stage of herb layer succession and consists of four layer types in PSME/PHMA. Two of these have been sampled (fig. 15). Most of the FRVE layer types sampled appear to be the successional result of clearcut areas that were scarified 10 to 18 years ago. All sites were well shaded by shrubs. Little or no grazing was evident on most of these sites.

CAREX GEYERI LAYER GROUP (CAGE L.G.)

Carex geyeri is a moderately shade-tolerant sedge found in many habitat types. In PSME/PHMA, it tends to grow in a bunch form, especially on dry granitic substrates, but on more moist sites it can become rhizomatous and develop a sparse sod. *Carex geyeri* has an extensive root system in proportion to its foliar coverage. A stand of mature *Carex* can fully occupy the soil even though above-ground interspaces may be as much as 3 feet (0.9 m). This characteristic makes *C. geyeri* an important plant cover on many steep, erodible slopes, but it also presents formidable root competition for other plants, including tree seedlings. This sedge can resprout following light scarification, and its seed has some ability to store in the soil (Kramer 1984). The stored seed apparently germinates best following clearcutting and scarification. In spring, *C. geyeri* is one of the first plants to produce new growth which has considerable forage value for elk and black bear (appendix C).

Aster conspicuus is a moderately shade-tolerant forb that can maintain extensive colonies beneath pine and open canopies of Douglas-fir. It can increase vegetatively by rhizomes when the tree canopy is reduced, and it apparently also increases following creeping ground fire. Its windblown seed provides long-distance dispersal and probably germinates on bare soil. In this manner, small amounts of *Aster* can establish following stand-destroying wildfire, or clearcutting with scarification. The *Aster* can then increase vegetatively to form extensive colonies, which persist on well-timbered sites. For this reason, *Aster conspicuus* is considered successional similar to *Carex geyeri* as an indicator of late seral conditions.

In PSME/PHMA, the CAGE layer group consists of three layer types; two of these were found (fig. 15). All of these sites had experienced a wildfire 16 to 125 years ago. Six of the sites had also experienced a clearcut with no site treatment 8 to 40 years ago, but the CAGE layer types involved merely survived the disturbance and did not result from it. These layer types most likely result from successional advance rather than direct response to disturbance. For classification purposes, the CAGE layer types are treated as late seral but in fact may be climax in drier portions of PSME/PHMA where *Calamagrostis*, *Arnica*, and *Thalictrum* have little or no potential.

CALAMAGROSTIS RUBESCENS LAYER GROUP (CARU L.G.)

Calamagrostis rubescens is a rhizomatous grass that can maintain high coverages under moderate shade as well as in openings. If well established, it can easily survive the impacts of clearcutting and broadcast burning.

With increased sunlight, *Calamagrostis* can renew its vigor and easily dominate the herb layer. The resulting sod presents severe competition for tree seedlings and requires either chemical or mechanical treatment for adequate tree seedling survival. The spring-summer forage value of *Calamagrostis* is considered high for black bear and elk (appendix C).

Arnica cordifolia is a shade-tolerant rhizomatous forb that can develop substantial coverages in clearcuts or beneath open stands of timber. But on most PSME/PHMA sites, *Arnica* displays low coverages beneath a shrub or tree canopy and persists in moderate shade more successfully than most other herb layer species. It shows little ability to increase from seed following any type of disturbance and, like most wind-dispersed species, does not store its seed in the soil (Kramer 1984). *Arnica* increases most effectively from residual plants following partial cutting without scarification, and it has moderate forage value for deer and elk (appendix C).

The CARU layer group consists of two layer types in PSME/PHMA, and both were found (fig. 15). Most of these sites had received little or no disturbance since the last wildfire 40 to 146 years ago. A few sites had experienced a timber harvest, but the impacts were too slight to alter the herb layer. The CARU layer types usually result from successional advance. It is not likely that they can generate directly from site treatment. In some cases, ineffective site treatment may allow a preexisting CARU layer type to remain intact and create a difficult situation for tree regeneration.

THALICTRUM OCCIDENTALE LAYER GROUP (THOC L.G.)

Thalictrum occidentale is a shade-tolerant rhizomatous forb that occasionally produces high coverages in PSME/PHMA. *Thalictrum fendleri* may also be present. It appears to be successional equivalent to *T. occidentale* and so is included with that species. No other species in the herb layer appears capable of replacing *Thalictrum* without the aid of disturbance. The *Thalictrum* coverage can be reduced by moderate scarification, burning, and in some cases, just removal of the tree canopy. *Thalictrum* does not appear capable of storing its seed in the soil (Kramer 1984) and has little or no forage value for big game and livestock (appendix C).

The THOC layer group consists of one layer type and is considered climax wherever found in PSME/PHMA. It usually results from successional advance and is not apt to be generated directly from site treatment. In some cases, however, ineffective site treatment may allow a preexisting THOC layer type to remain intact. This layer type was found mainly on sites that had not been disturbed for 50 to 100 years. One site had been recently logged, but *Thalictrum* had survived the disturbance. None of these sites were being grazed.

MANAGEMENT IMPLICATIONS

Management implications of the herbaceous layer focus on relative forage values to big game and livestock. A relative index to forage preferences by herb layer type was

developed by the same method used for the shrub layer (see shrub layer for details). Range and wildlife managers who have better palatability ratings for a local area can easily recalculate the forage preference indexes from appendix C. Users of table 19 should consider the often small sample size of some layer types and possible revision of index values with increased sampling. As more data become available, these forage preference indexes can provide general guidelines to grazing potential for specific management objectives. When both herb and shrub layer types are known for a given site, the index values assigned in table 19 can be added to those in table 9 to give a total forage index for that site.

Deer—Herb layer forage values for deer in summer are generally low throughout PSME/PHMA succession. Two exceptions are the ANN-ILRI and POGL-FRVE herb layer types which have moderate value (table 19). These higher values hinge mainly on higher coverages of *Iliamna* and *Fragaria*, which have moderate palatability for deer (appendix C). High coverages of *Iliamna* can only be achieved through high-intensity burning. High coverages of *Fragaria* are best achieved through successional advance of well-scarified, partially shaded sites.

Forage values for deer in winter are low to nil; the only exception being POGL-FRVE, which has moderate value. This higher value is again due to high coverages of *Fragaria*, which often retains green leaves beneath the snow and has moderate palatability for deer in winter.

Elk—Forage values for elk in summer are mostly low in PSME/PHMA herb layers. Only the ANN-BRCA, ANN-ILRI, and FRVE-CARU layer types have moderate value (table 19). High coverages and palatability of *Bromus carinatus*, *Iliamna*, and *Calamagrostis* are mainly responsible for these higher forage values (appendix C). All of these species are favored by burning. *Bromus carinatus* will also colonize scarified areas and responds well to direct seeding.

Forage values for elk in winter are low to nil except for the POGL-FRVE layer type, which has moderate value. The moderate winter forage value of *Fragaria* is mainly responsible for the higher index of POGL-FRVE.

Cattle—Forage values for cattle are generally low in all stages of PSME/PHMA succession (table 19). The only exception is the ANN-ILRI layer type, which has moderate value due to the high coverage and moderate palatability of *Iliamna*. This species can be generated from buried seed by intense burning. But *Iliamna* seed is not always present on PSME/PHMA sites, and intense burning also generates high coverages of *Ceanothus*, which often deters cattle use of the site.

Sheep—Most herb layer types in PSME/PHMA have low forage value for sheep. Only the ANN-ILRI, POGL-FRVE, and FRVE-CARU layer types have moderate value. These three layer types also ranked highest in value for either deer or elk (table 19). This suggests that some competition between wildlife and livestock exists for the forage resource in the herb layer.

Table 19—Relative index classes of big-game and livestock forage preferences by herb layer types in the PSME/PHMA h.t., PIPO phase¹

Layer group layer type	No. of stands	Deer		Elk		Cattle	Sheep	Black bear		
		SU ²	W	SU	W	SU	SU	SP	SU	F
Annuals										
ANN.-ANN.	3	3 ¹	0	1	0	1	1	0	0	0
ANN.-BRCA	2	2	1	3	1	2	2	1	0	0
ANN.-POGL	2	1	0	1	0	1	1	0	0	0
ANN.-ILRI	1	3	0	4	0	3	4	0	0	0
ANN.-CAGE	1	1	0	2	1	2	2	1	0	0
ANN.-CARU	1	0	0	1	0	0	1	1	0	0
<i>Bromus carinatus</i>										
BRCA-BRCA	3	1	1	1	1	2	1	0	0	0
BRCA-FRVE	1	2	1	2	1	2	2	0	0	0
<i>Potentilla glandulosa</i>										
POGL-POGL	5	1	0	1	1	1	1	0	0	0
POGL-EPAN	2	2	1	2	1	1	2	0	0	0
POGL-FRVE	1	4	3	2	3	2	4	1	4	1
<i>Iliamna rivularis</i>										
ILRI-ILRI	1	1	0	1	0	1	1	0	0	0
<i>Epilobium angustifolium</i>										
EPAN-EPAN	3	1	1	1	1	1	1	0	0	0
EPAN-APAN	1	2	1	2	1	1	2	0	0	0
EPAN-CARU	2	1	1	2	1	1	1	1	0	0
EPAN-THOC	1	1	1	2	1	1	1	0	0	0
<i>Apocynum androsaemifolium</i>										
APAN-APAN	2	1	0	1	0	1	1	0	0	0
APAN-CAGE	1	2	1	2	2	2	2	1	1	1
<i>Fragaria vesca</i>										
FRVI-CAGE	1	2	2	2	2	2	2	1	2	1
FRVI-CARU	3	2	2	3	2	2	3	2	2	1
<i>Carex geyeri</i>										
CAGE-CAGE	21	1	1	2	2	2	1	2	1	1
CAGE-CARU	5	1	1	2	1	2	1	1	1	0
<i>Calamagrostis rubescens</i>										
CARU-CARU	25	1	1	2	1	1	1	1	1	0
CARU-THOC	2	1	0	2	0	1	1	0	0	0
<i>Thalictrum occidentale</i>										
THOC-THOC	10	1	0	1	0	1	1	0	0	0

¹Based on palatability ratings by Kufeld (1973), Kufeld and others (1973), USDA FS (1986), and Beecham (1981).

²SP = spring (March, April, May); SU = summer (June, July, August); F = fall (September, October, November); W = winter (December, January, February).

³Code to index classes: 0 = 0-50; 1 = 51-150; 2 = 151-250 (low)
3 = 251-350; 4 = 351-450; 5 = 451-550 (moderate)
6 = 551-650; 7 = 651-750; 8 = 751-850 (high).

Black Bear—Forage values for black bear are low to nil in all herb layer types except POGL-FRVE (table 7). The moderate forage value of POGL-FRVE depends mainly on production of *Fragaria* fruits in the summer. This fruiting, however, may not be consistent nor proportional to the *Fragaria* cover as the forage index suggests.

Pocket Gophers—Some relationships between pocket gopher populations and silvicultural activities were previously discussed (see tree layer section). Scarification without burning resulted in the most gopher activity (table 4). Scarification generally produces early seral herb layers that classify as being in the Annuals and POGL herb layer groups (fig. 19). Apparently herb layers in these two groups stimulate gopher populations. The scarification can result from either machinery or heavy livestock use and may account for the observed correlation between heavy grazing and high gopher activity in other areas (Buechner 1942). The relationship between gopher activity and early seral herb layers created by scarification without burning was also found in other habitat types (Steele and Geier-Hayes 1985, 1986). Other types of disturbance, such as broadcast burning, generally result in either a depauperate or more successional advanced herb layer type and often result in less gopher activity.

In summarizing studies of pocket gophers, Teipner and others (1983) suggest that plant species composition and abundance are the main regulators of gopher density. More specifically, Andersen and MacMahon (1981) correlated gopher population decline in a spruce-fir forest with decreasing palatable vegetation due to advancing successional stages. Succession in PSME/PHMA, especially the

herbaceous layer, also appears related to gopher activity. Here occurrence and number of gopher mounds were tallied in either a 50-m² or a 375-m² circular plot and summarized according to herb layer type. Because not all gopher activity results in new mounds, the number of mounds may not reflect actual gopher density throughout the soil profile but should indicate relative activity between sites in the upper soil profile where feeding occurs. Teipner and others (1983) note several studies in which number of mounds indicated the relative abundance of gophers.

Figure 20 shows that relative gopher activity is highest in early seral herbaceous layers, especially the Annuals, BRCA, and POGL layer groups, and is considerably less in the late seral to climax conditions. This trend is similar to that found by Andersen and MacMahon (1981) and suggests that certain early seral species may provide the greatest benefit to gophers. In laboratory feeding tests, gophers gained weight on exclusive diets of both *Taraxacum* and *Erigeron*, and their subsistence was marginal on *Bromus carinatus* and *Bromus inermis* (Tietjen and others 1967). All of these taxa would be considered early seral species in PSME/PHMA (fig. 20). In contrast, gophers died on exclusive diets of *Geranium* (Tietjen and others 1967) and *Epilobium angustifolium* (Andersen and MacMahon 1985), both of which are mid-seral species. Although inconclusive at this point, additional feeding tests using a wider variety of plant species may substantiate this trend and show what kinds of herb layers are best suited for gopher control.



Figure 19—A POGL-POGL herb layer type supporting a high level of pocket gopher activity. This site was clearcut and thoroughly scarified 18 years ago. The *Potentilla* germinated from buried seed in response to the scarification. These POGL herb layer types generally support more gopher activity than most other herb layers in PSME/PHMA.



Figure 20—Constancy and average number per acre of pocket gopher mounds in various herb layer types (n = number of samples in each layer type).

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APPENDIX A: CONSTANCY¹ AND AVERAGE CANOPY COVER (PERCENT) OF TREES BY LAYER TYPE IN THE PSME/PHMA H.T., PIPO PHASE, SHOWING SIZE CLASS DISTRIBUTION AND AVERAGE BASAL AREA

Populus tremuloides													
TREE LAYER GROUP		POTR - POTR											
Tree layer type		s. POTR - s. POTR				s. POTR - p. POTR				p. POTR - m. POTR			
Number of stands		n = 1				n = 2				n = 1			
Size classes (inches)		>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4
ADP No.	Tree species												
013	Pinus ponderosa	—	—	—	10(3.0)	—	—	—	—	—	—	—	—
014	Populus tremuloides	—	—	—	10(15.0)	—	—	10(37.5)	10(15.0)	—	—	10(37.5)	—
016	Pseudotsuga menziesii	—	—	—	—	—	—	—	—	—	—	—	10(0.5)
Average basal area (ft²/acre)		4				—				92			
Pinus ponderosa													
TREE LAYER GROUP		PIPO - PIPO											
Tree layer type		s. PIPO - s. PIPO				s. PIPO - p. PIPO				s. PIPO - o.g. PIPO			
Number of stands		n = 16				n = 2				n = 1			
Size classes (inches)		>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4
ADP No.	Tree species												
013	Pinus ponderosa	—	1(3.0)	4(3.0)	10(19.0)	—	5(3.0)	10(15.0)	10(15.0)	10(37.5)	—	10(3.0)	10(15.0)
014	Populus tremuloides	—	—	—	—	—	—	—	—	—	—	—	—
016	Pseudotsuga menziesii	—	—	1(3.0)	5(1.1)	—	—	5(3.0)	10(7.8)	10(3.0)	—	10(15.0)	10(15.0)
Average basal area (ft²/acre)		12				—				250			
Pinus ponderosa													
TREE LAYER GROUP		PIPO - PIPO											
Tree layer type		p. PIPO - p. PIPO				p. PIPO - m. PIPO				p. PIPO - o.g. PIPO			
Number of stands		n = 7				n = 1				n = 2			
Size classes (inches)		>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4
ADP No.	Tree species												
013	Pinus ponderosa	—	1(15.0)	10(21.4)	9(2.1)	—	10(37.5)	10(15.0)	—	10(26.0)	—	10(15.0)	5(3.0)
014	Populus tremuloides	—	—	—	—	—	—	—	—	—	—	—	—
016	Pseudotsuga menziesii	1(15.0)	—	4(7.0)	7(2.0)	—	10(10.0)	—	10(15.0)	—	—	10(1.2)	—
Average basal area (ft²/acre)		—				302				136			

¹Code to constancy values: + = 0 - 5% 2 = 15 - 25% 4 = 35 - 45% 6 = 55 - 65% 8 = 75 - 85% 10 = 95 - 100%
 1 = 5 - 15% 3 = 25 - 35% 5 = 45 - 55% 7 = 65 - 75% 9 = 85 - 95%

(con.)

APPENDIX A (Con.)¹

<i>Pinus ponderosa</i>									
TREE LAYER GROUP		PIPO - PIPO			PIPO - PSME				
Tree layer type		o.g. PIPO - o.g. PIPO			s. PIPO - s. PSME				
Size class notation		n = 4			n = 2				
Number of stand									
Size classes (inches)		>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4
ADP No. Tree species									
013 <i>Pinus ponderosa</i>		10(32.0)	2(3.0)	2(3.0)	10(1.1)	—	—	10(6.0)	10(15.0)
015 <i>Populus tremuloides</i>		—	—	—	—	—	—	—	—
016 <i>Pseudotsuga menziesii</i>		2(15.0)	2(10.0)	8(7.0)	8(6.2)	—	5(3.0)	10(3.0)	10(15.0)
Average basal area (ft ² /acre)			204				28		103
<i>Pinus ponderosa</i>									
TREE LAYER GROUP		PIPO - PIPO			PIPO - PSME				
Tree layer type		p. PIPO - m. PSME			p. PIPO - o.g. PSME				
Size class notation		n = 2			n = 1				
Number of stands									
Size classes (inches)		>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4
ADP No. Tree species									
013 <i>Pinus ponderosa</i>		—	5(15.0)	10(26.2)	10(1.8)	—	10(15.0)	10(15.0)	10(3.0)
014 <i>Populus tremuloides</i>		—	—	—	—	—	—	—	—
016 <i>Pseudotsuga menziesii</i>		—	10(37.5)	10(7.8)	10(7.8)	10(37.5)	—	10(15.0)	10(15.0)
Average basal area (ft ² /acre)			112				62		95
<i>Pinus ponderosa</i>									
TREE LAYER GROUP		PIPO - PIPO			PIPO - PSME				
Tree layer type		m. PIPO - m. PSME			o.g. PIPO - s. PSME				
Size class notation		n = 3			n = 6				
Number of stands									
Size classes (inches)		>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4
ADP No. Tree species									
013 <i>Pinus ponderosa</i>		3(15.0)	10(15.0)	7(1.8)	7(1.8)	10(26.2)	2(3.0)	3(3.0)	5(2.2)
014 <i>Populus tremuloides</i>		—	—	—	—	—	—	—	—
016 <i>Pseudotsuga menziesii</i>		10(15.0)	10(37.5)	10(15.0)	7(9.0)	3(15.0)	—	8(14.0)	10(24.6)
Average basal area (ft ² /acre)			204				149		176

¹Code to constancy values: + = 0 - 5% 2 = 15 - 25% 4 = 35 - 45% 6 = 55 - 65% 8 = 75 - 85% 10 = 95 - 100%
1 = 5 - 15% 3 = 25 - 35% 5 = 45 - 55% 7 = 65 - 75% 9 = 85 - 95% (con.)

APPENDIX A (Con.)¹

TREE LAYER GROUP		<i>Pinus ponderosa</i>				<i>Pseudotsuga menziesii</i>			
Tree layer type		PSME - PSME				PSME - PSME			
Size class notation		o.g. PIPO - m. PSME				o.g. PIPO - o.g. PSME			
Number of stands		n = 1				n = 1			
Size classes (inches)		>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4
ADP No. Tree species									
013	<i>Pinus ponderosa</i>	10(15.0)	—	—	—	10(15.0)	10(3.0)	—	—
014	<i>Populus tremuloides</i>	—	—	—	—	—	—	—	—
016	<i>Pseudotsuga menziesii</i>	—	10(15.0)	—	—	10(15.0)	—	10(3.0)	10(0.5)
Average basal area (ft ² /acre)		74				204			58

TREE LAYER GROUP		<i>Pseudotsuga menziesii</i>				<i>Pseudotsuga menziesii</i>			
Tree layer type		PSME - PSME				PSME - PSME			
Size class notation		s. PSME - p. PSME				s. PSME - o.g. PSME			
Number of stands		n = 7				n = 2			
Size classes (inches)		>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4
ADP No. Tree species									
013	<i>Pinus ponderosa</i>	—	—	3(1.8)	4(1.3)	—	—	—	5(0.5)
014	<i>Populus tremuloides</i>	—	—	—	—	—	—	—	—
016	<i>Pseudotsuga menziesii</i>	3(15.0)	7(11.6)	10(28.9)	10(15.0)	10(26.2)	5(3.0)	10(9.0)	10(15.0)
Average basal area (ft ² /acre)		119				70			109

TREE LAYER GROUP		<i>Pseudotsuga menziesii</i>				<i>Pseudotsuga menziesii</i>			
Tree layer type		PSME - PSME				PSME - PSME			
Size class notation		p. PSME - m. PSME				p. PSME - o.g. PSME			
Number of stands		n = 7				n = 3			
Size classes (inches)		>18	18 - 12	12 - 4	<4	>18	18 - 12	12 - 4	<4
ADP No. Tree species									
013	<i>Pinus ponderosa</i>	—	4(3.0)	3(3.0)	3(0.5)	—	—	—	7(0.5)
014	<i>Populus tremuloides</i>	—	—	—	—	—	—	—	3(0.5)
016	<i>Pseudotsuga menziesii</i>	7(12.6)	10(25.7)	10(14.3)	10(1.9)	10(24.2)	3(15.0)	10(15.0)	7(1.8)
Average basal area (ft ² /acre)		115				157			211

¹Code to constancy values: + = 0 - 5% 2 = 15 - 25% 4 = 35 - 45% 6 = 55 - 65% 8 = 75 - 85% 10 = 95 - 100%
1 = 5 - 15% 3 = 25 - 35% 5 = 45 - 55% 7 = 65 - 75% 9 = 85 - 95% (con.)

APPENDIX A (Con.)¹

TREE LAYER GROUP		<i>Pseudotsuga menziesii</i>				
Tree layer type		PSME - PSME				
Size class notation		o.g. PSME - o.g. PSME				
Number of stands		n = 1				
Size classes (Inches)		>18	18 - 12	12 - 4	<4	
ADP No.	Tree species					
013	<i>Pinus ponderosa</i>	10 (3.0)	—	—	—	
014	<i>Populus tremuloides</i>	—	—	—	—	
016	<i>Pseudotsuga menziesii</i>	10(15.0)	—	10 (3.0)	10(0.5)	
Average basal area (ft ² /acre)		197				

¹Code to constancy values: + = 0 - 5% 2 = 15 - 25% 4 = 35 - 45% 6 = 55 - 65% 8 = 75 - 85% 10 = 95 - 100%
 1 = 5 - 15% 3 = 25 - 35% 5 = 45 - 55% 7 = 65 - 75% 9 = 85 - 95%

**APPENDIX B-1: PALATABILITY RATINGS, CONSTANCY,¹ AND AVERAGE
CANOPY COVER (PERCENT) OF SHRUBS BY LAYER TYPE IN THE PSME/
PHMA H.T., PIPO PHASE**

SHRUB LAYER GROUP													
Shrub layer type													
Number of stands													
Palatability ratings ²													
ADP No.	Shrub species	Deer		Elk		Cattle	Sheep	Black bear			Spring	Summer	Fall
		Summer	Winter	Summer	Winter			Spring	Summer	Fall			
102	<i>Acer glabrum</i>	4	6	6	6	4	4	0	0	0	0	0	0
105	<i>Amelanchier alnifolia</i>	4	4	6	6	3	5	2	6	6	2	4	4
203	<i>Berberis repens</i>	2	4	2	4	2	3	2	4	4	2	4	4
198	<i>Ceanothus sanguineus</i>	6	4	6	6	2	2	0	0	0	0	0	0
107	<i>Ceanothus velutinus</i>	6	4	6	6	2	2	0	0	0	0	0	0
108	<i>Chrysothamnus nauseosus</i>	2	4	0	4	2	2	0	0	0	0	0	0
111	<i>Holodiscus discolor</i>	0	0	0	0	0	0	0	0	0	0	0	0
115	<i>Lonicera utahensis</i>	2	4	6	4	2	2	2	4	4	2	4	4
119	<i>Philadelphus lewisii</i>	2	2	2	6	2	4	0	0	0	0	0	0
122	<i>Physocarpus malvaceus</i>	4	2	4	2	2	4	0	0	0	0	0	0
123	<i>Prunus emarginata</i>	4	0	6	0	2	2	2	4	6	2	4	6
124	<i>Prunus virginiana</i>	4	4	4	6	2.5	3	2	4	6	2	4	6
125	<i>Purshia tridentata</i>	6	6	0	6	4	6	0	0	0	0	0	0
149	<i>Rhamnus purshiana</i>	0	0	0	0	0	0	0	0	0	0	0	0
128	<i>Ribes cereum</i>	0	2	2	0	2	2.5	2	6	4	2	6	4
131	<i>Ribes viscosissimum</i>	0	0	6	0	2	3	2	6	4	2	6	4
133	<i>Rosa gymnocarpa</i>	6	4	6	4	2	4	0	0	0	0	0	0
161	<i>Rosa nutkana</i>	6	4	6	4	2	4	0	0	0	0	0	0
136	<i>Rubus parviflorus</i>	4	2	6	2	2	4	2	4	2	2	4	2
137	<i>Salix scouleriana</i>	6	0	0	4	2	3	0	0	0	0	0	0
164	<i>Sambucus cerulea</i>	6	2	6	0	3	4	2	2	2	2	2	2
140	<i>Sorbus scopulina</i>	6	0	6	4	0	0	2	2	6	2	2	6
142	<i>Spiraea betulifolia</i>	4	2	0	4	2	3	0	0	0	0	0	0
143	<i>Symphoricarpos albus</i>	4	2	6	6	2	4	2	2	2	2	2	2
163	<i>Symphoricarpos oreophilus</i>	4	3	4	0	2	3	2	2	2	2	2	2
146	<i>Vaccinium globulare</i>	6	4	6	2	2	4	2	6	4	2	6	4

¹Code to constancy values: + = 0 - 5% 2 = 15-25% 4 = 35-45% 6 = 55-65% 8 = 75-85% 10 = 95-100%

1 = 5-15% 3 = 25-35% 5 = 45-55% 7 = 65-75% 9 = 85-95%

²Palatability ratings are from Kufeld and others (1973), Kufeld (1973), USDA FS (1986), and Beecham (1981).

(con.)

APPENDIX B-1 (Con.)

SHRUB LAYER GROUP		<i>Ceanothus velutinus</i>							
Shrub layer type	CEVE -CEVE	CEVE -RICE	CEVE -SASC	CEVE -PREM	CEVE -AMAL	CEVE -SPBE	CEVE -PHMA		
Number of stands	n = 6	n = 2	n = 10	n = 2	n = 3	n = 10	n = 15		
ADP									
No.	Shrub species								
102	<i>Acer glabrum</i>	2(0.5)	5(3.0)	6(10.6)	—	2(3.0)	5(6.4)		
105	<i>Amelanchier alnifolia</i>	8(4.4)	5(3.0)	7(7.8)	5(3.0)	10(4.1)	9(1.8)		
203	<i>Berberis repens</i>	5(0.5)	—	1(0.5)	—	4(1.1)	3(0.5)		
198	<i>Ceanothus sanguineus</i>	3(73.8)	—	5(19.0)	—	3(37.5)	2(11.0)		
107	<i>Ceanothus velutinus</i>	8(54.1)	10(15.0)	8(21.9)	10(15.0)	10(13.8)	9(21.9)		
108	<i>Chrysothamnus nauseosus</i>	2(0.5)	5(0.5)	—	5(0.5)	—	2(0.5)		
111	<i>Holodiscus discolor</i>	—	—	—	—	—	—		
115	<i>Lonicera utahensis</i>	—	—	4(1.1)	—	—	1(0.5)		
119	<i>Philadelphus lewisii</i>	—	—	1(3.0)	—	—	—		
122	<i>Physocarpus malvaceus</i>	10(22.5)	10(9.0)	10(24.0)	10(15.0)	10(30.0)	10(47.5)		
123	<i>Prunus emarginata</i>	5(3.0)	5(15.0)	3(7.0)	10(26.3)	3(15.0)	6(10.1)		
124	<i>Prunus virginiana</i>	2(0.5)	5(0.5)	—	5(15.0)	7(1.8)	3(4.8)		
125	<i>Purshia tridentata</i>	—	—	1(0.5)	5(0.5)	10(0.5)	1(0.5)		
149	<i>Rhamnus purshiana</i>	—	—	1(0.5)	—	—	—		
128	<i>Ribes cereum</i>	—	5(3.0)	1(0.5)	5(3.0)	7(1.8)	1(0.5)		
131	<i>Ribes viscosissimum</i>	3(0.5)	10(26.3)	4(0.5)	5(0.5)	—	3(1.1)		
133	<i>Rosa gymnocarpa</i>	3(1.8)	—	3(0.5)	—	—	2(0.5)		
161	<i>Rosa nutkana</i>	3(0.5)	—	3(1.3)	5(0.5)	3(0.5)	3(0.5)		
136	<i>Rubus parviflorus</i>	3(0.5)	—	5(4.9)	—	—	3(1.1)		
137	<i>Salix scouleriana</i>	7(3.0)	10(1.8)	10(50.0)	5(0.5)	7(1.8)	6(7.2)		
164	<i>Sambucus cerulea</i>	2(15.0)	5(15.0)	—	—	2(1.8)	4(0.9)		
140	<i>Sorbus scopulina</i>	—	—	5(4.9)	—	—	2(2.2)		
142	<i>Spiraea betulifolia</i>	10(15.3)	10(3.0)	10(13.0)	5(3.0)	10(7.0)	9(5.7)		
143	<i>Symphoricarpos albus</i>	5(0.5)	—	5(6.3)	—	7(7.8)	1(9.0)		
163	<i>Symphoricarpos oreophilus</i>	2(15.0)	10(3.0)	2(1.8)	10(7.8)	10(7.0)	6(3.2)		
146	<i>Vaccinium globulare</i>	—	—	3(12.8)	—	—	1(3.0)		

*Code to constancy values: + = 0-5% 2 = 15-25% 4 = 35-45% 6 = 55-65% 8 = 75-85% 10 = 95-100% (con.)
1 = 5-15% 3 = 25-35% 5 = 45-55% 7 = 65-75% 9 = 85-95%

APPENDIX B-1 (Con.)¹

SHRUB LAYER GROUP			<i>Ribes cereum</i>			<i>Salix scouleriana</i>				<i>Prunus emarginata</i>			
Shrub layer type		RICE -RICE	RICE -AMAL	RICE -PHMA	SASC -SASC	SASC -AMAL	SASC -SPBE	SASC -PHMA	PREM -PREM	PREM -AMAL	PREM -SPBE	PREM -PHMA	
Number of stands		<i>n</i> = 2	<i>n</i> = 2	<i>n</i> = 1	<i>n</i> = 3	<i>n</i> = 3	<i>n</i> = 4	<i>n</i> = 17	<i>n</i> = 2	<i>n</i> = 1	<i>n</i> = 1	<i>n</i> = 8	
ADP	Shrub species												
No.													
102	<i>Acer glabrum</i>	5(0.5)	—	—	7(1.8)	7(0.5)	10(4.8)	4(8.6)	10(1.8)	—	—	4(3.0)	
105	<i>Amelanchier alnifolia</i>	10(1.8)	10(9.0)	10(0.5)	3(3.0)	10(30.0)	10(1.8)	9(6.3)	10(9.0)	—	10(0.5)	6(9.7)	
203	<i>Berberis repens</i>	5(0.5)	10(0.5)	10(0.5)	3(0.5)	7(1.8)	—	4(1.2)	10(1.8)	10(15.0)	—	5(0.5)	
198	<i>Ceanothus sanguineus</i>	—	—	—	—	—	5(3.0)	1(3.0)	—	—	—	3(0.5)	
107	<i>Ceanothus velutinus</i>	5(3.0)	10(1.8)	10(0.5)	7(1.8)	7(3.0)	5(1.8)	4(2.3)	—	10(3.0)	10(3.0)	4(1.3)	
108	<i>Chrysothamnus nauseosus</i>	—	—	—	—	—	—	1(0.5)	5(0.5)	—	—	1(0.5)	
111	<i>Holodiscus discolor</i>	—	—	—	—	—	—	—	—	—	—	—	
115	<i>Lonicera utahensis</i>	5(0.5)	—	—	3(15.0)	3(3.0)	5(3.0)	1(1.8)	—	—	—	—	
119	<i>Philadelphus lewisii</i>	—	—	—	—	—	—	1(15.0)	—	—	—	1(3.0)	
122	<i>Physocarpus malvaceus</i>	10(15.0)	10(15.0)	10(37.5)	10(18.5)	10(15.0)	10(14.6)	10(46.8)	10(26.3)	10(3.0)	10(15.0)	10(46.9)	
123	<i>Prunus emarginata</i>	10(1.8)	10(0.5)	—	3(0.5)	3(0.5)	5(15.0)	3(17.1)	10(26.3)	—	10(15.0)	9(13.3)	
124	<i>Prunus virginiana</i>	—	—	—	3(15.0)	—	—	2(5.3)	10(26.3)	10(15.0)	10(3.0)	8(8.6)	
125	<i>Purshia tridentata</i>	—	—	—	—	3(0.5)	—	1(0.5)	—	—	—	—	
149	<i>Rhamnus purshiana</i>	—	—	—	—	—	—	—	—	—	—	—	
128	<i>Ribes cereum</i>	10(26.3)	10(15.0)	—	—	—	3(0.5)	1(0.5)	5(3.0)	10(0.5)	—	—	
131	<i>Ribes viscosissimum</i>	10(1.8)	5(3.0)	10(15.0)	7(1.8)	3(0.5)	5(1.8)	2(0.5)	5(0.5)	—	—	1(0.5)	
133	<i>Rosa gymnocarpa</i>	—	—	—	—	3(0.5)	5(0.5)	3(2.5)	—	—	—	1(0.5)	
161	<i>Rosa nutkana</i>	—	5(0.5)	—	3(0.5)	—	5(0.5)	2(1.1)	—	10(15.0)	10(0.5)	3(0.5)	
136	<i>Rubus parviflorus</i>	—	—	—	3(0.5)	—	3(62.5)	2(9.0)	—	—	—	—	
137	<i>Salix scouleriana</i>	10(3.0)	—	10(0.5)	10(45.8)	10(30.0)	10(20.6)	9(19.5)	—	—	10(0.5)	5(2.4)	
164	<i>Sambucus cerulea</i>	5(3.0)	—	10(0.5)	3(0.5)	—	—	1(0.5)	—	—	—	—	
140	<i>Sorbus scopulina</i>	—	—	—	—	—	3(0.5)	2(10.2)	—	—	—	3(0.5)	
142	<i>Spiraea betulifolia</i>	10(1.8)	10(1.8)	10(3.0)	10(10.2)	10(7.0)	10(31.9)	9(11.4)	5(0.5)	10(3.0)	10(15.0)	6(14.2)	
143	<i>Symphoricarpos albus</i>	—	—	—	—	3(15.0)	—	4(15.4)	—	—	—	—	
163	<i>Symphoricarpos oreophilus</i>	10(3.0)	10(37.5)	10(3.0)	3(0.5)	7(1.8)	5(1.8)	4(2.9)	10(9.0)	10(37.5)	—	8(7.0)	
146	<i>Vaccinium globulare</i>	—	—	—	—	7(1.8)	—	1(50.0)	—	—	—	1(3.0)	

¹Code to constancy values: + = 0- 5% 2 = 15-25% 3 = 25-35% 4 = 35-45% 5 = 45-55% 6 = 55-65% 7 = 65-75% 8 = 75-85% 9 = 85-95% 10 = 95-100%
1 = 5-15%

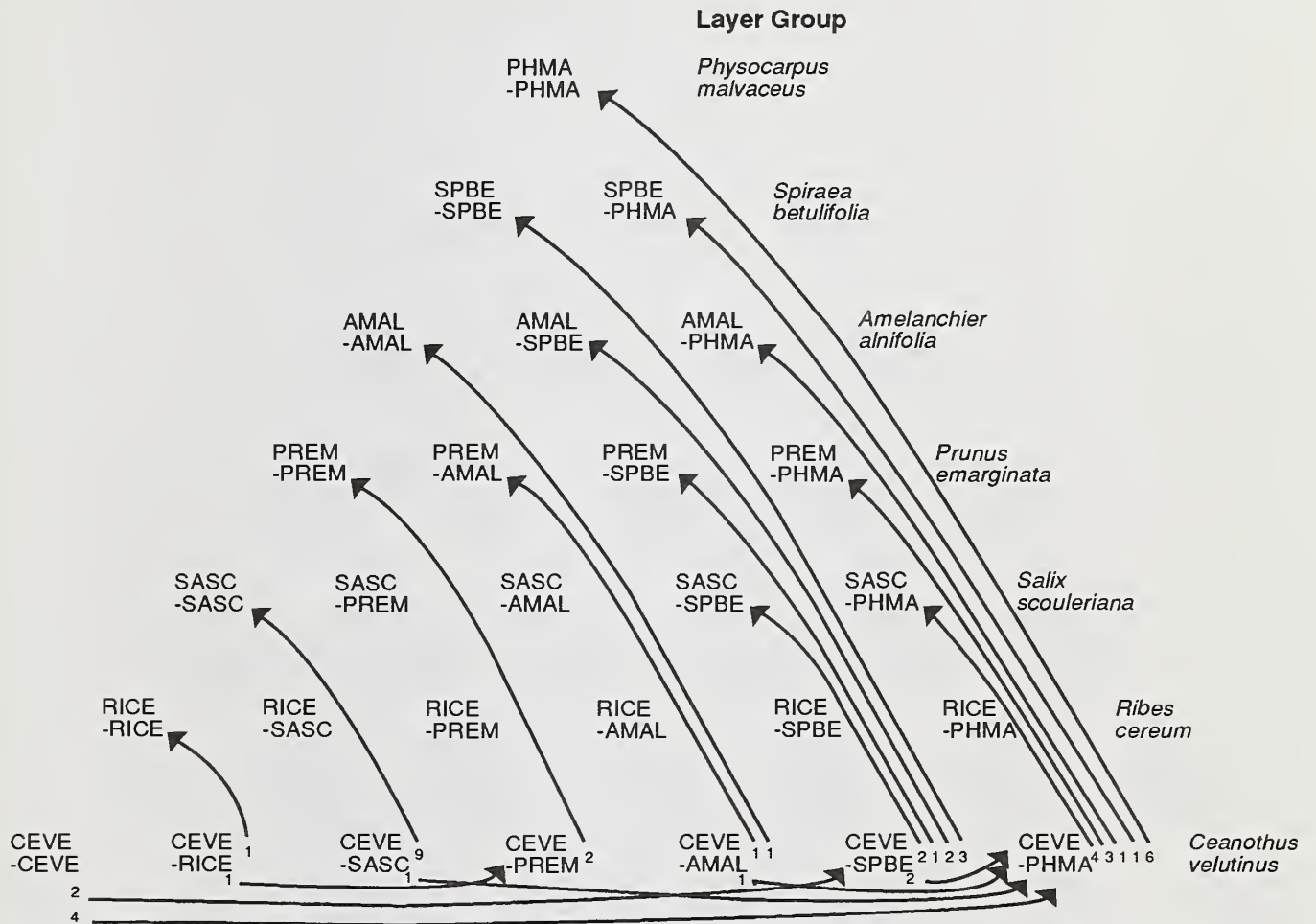
(con.)

APPENDIX B-1 (Con.)¹

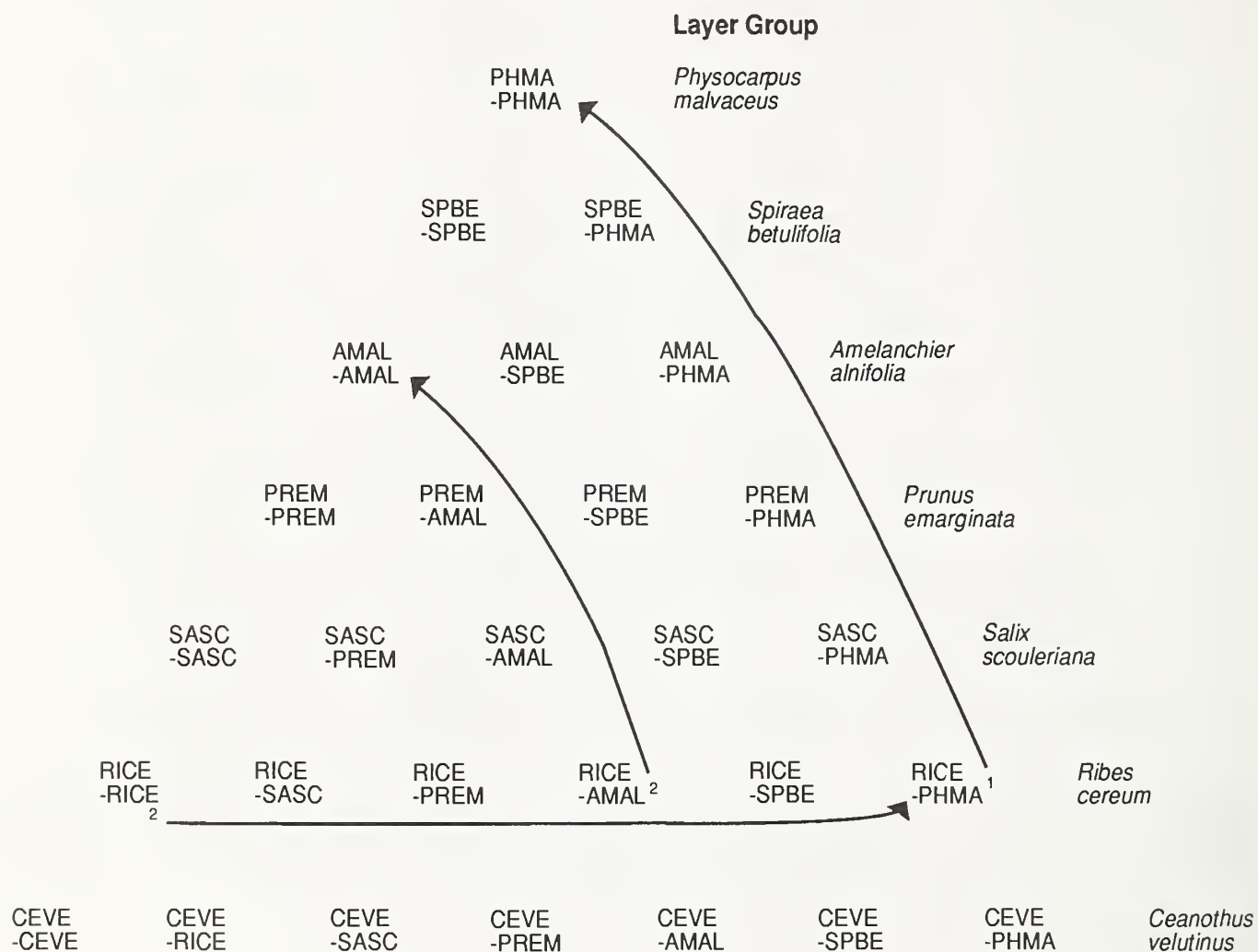
SHRUB LAYER GROUP		<i>Amelanchier alnifolia</i>		<i>Spiraea betulifolia</i>		<i>Physocarpus malvaceus</i>
Shrub layer type		AMAL -SPBE	AMAL -PHMA	SPBE -SPBE	SPBE -PHMA	PHMA -PHMA
Number of stands		n = 5	n = 10	n = 3	n = 20	n = 21
ADP						
No.	Shrub species					
102	<i>Acer glabrum</i>	8(1.8)	6(14.8)	3(15.0)	4(12.7)	4(5.4)
105	<i>Amelanchier alnifolia</i>	10(16.6)	10(16.0)	10(2.2)	10(1.9)	8(2.2)
203	<i>Berberis repens</i>	8(0.5)	4(1.1)	7(31.5)	6(0.9)	4(0.5)
198	<i>Ceanothus sanguineus</i>	—	—	—	0(0.5)	—
107	<i>Ceanothus velutinus</i>	2(3.0)	3(1.3)	3(0.5)	4(2.2)	3(1.3)
108	<i>Chrysothamnus nauseosus</i>	—	—	—	—	0(0.5)
111	<i>Holodiscus discolor</i>	—	—	—	1(11.0)	0(3.0)
115	<i>Lonicera utahensis</i>	2(0.5)	1(0.5)	3(0.5)	1(0.5)	1(1.8)
119	<i>Philadelphus lewisii</i>	—	—	3(3.0)	1(0.5)	1(3.0)
122	<i>Physocarpus malvaceus</i>	10(28.5)	10(63.3)	10(15.0)	10(57.1)	10(61.9)
123	<i>Prunus emarginata</i>	—	6(1.8)	—	2(1.1)	4(1.1)
124	<i>Prunus virginiana</i>	—	3(1.3)	3(0.5)	4(1.6)	3(1.2)
125	<i>Purshia tridentata</i>	—	—	—	1(0.5)	0(3.0)
149	<i>Rhamnus purshiana</i>	—	—	—	—	—
128	<i>Ribes cereum</i>	—	1(3.0)	—	—	0(3.0)
131	<i>Ribes viscosissimum</i>	—	—	7(1.8)	—	0(0.5)
133	<i>Rosa gymnocarpa</i>	2(0.5)	—	—	4(0.5)	2(2.4)
161	<i>Rosa nutkana</i>	2(0.5)	3(0.5)	3(15.0)	2(0.5)	1(0.5)
136	<i>Rubus parviflorus</i>	4(0.5)	1(0.5)	3(0.5)	0(0.5)	0(3.0)
137	<i>Salix scouleriana</i>	2(0.5)	2(3.0)	—	3(2.2)	2(2.0)
164	<i>Sambucus cerulea</i>	—	—	—	—	0(0.5)
140	<i>Sorbus scopulina</i>	4(0.5)	—	—	1(0.5)	0(0.5)
142	<i>Spiraea betulifolia</i>	10(42.5)	10(17.9)	10(12.8)	9(21.3)	7(1.6)
143	<i>Symphoricarpos albus</i>	2(15.0)	1(3.0)	7(37.5)	4(18.8)	4(1.9)
163	<i>Symphoricarpos oreophilus</i>	6(6.2)	9(3.5)	3(0.5)	4(2.1)	5(1.9)
146	<i>Vaccinium globulare</i>	—	—	—	—	—

¹Code to constancy values: + = 0-5% 2 = 15-25% 4 = 35-45% 6 = 55-65% 8 = 75-85% 10 = 95-100%
 1 = 5-15% 3 = 25-35% 5 = 45-55% 7 = 65-75% 9 = 85-95%

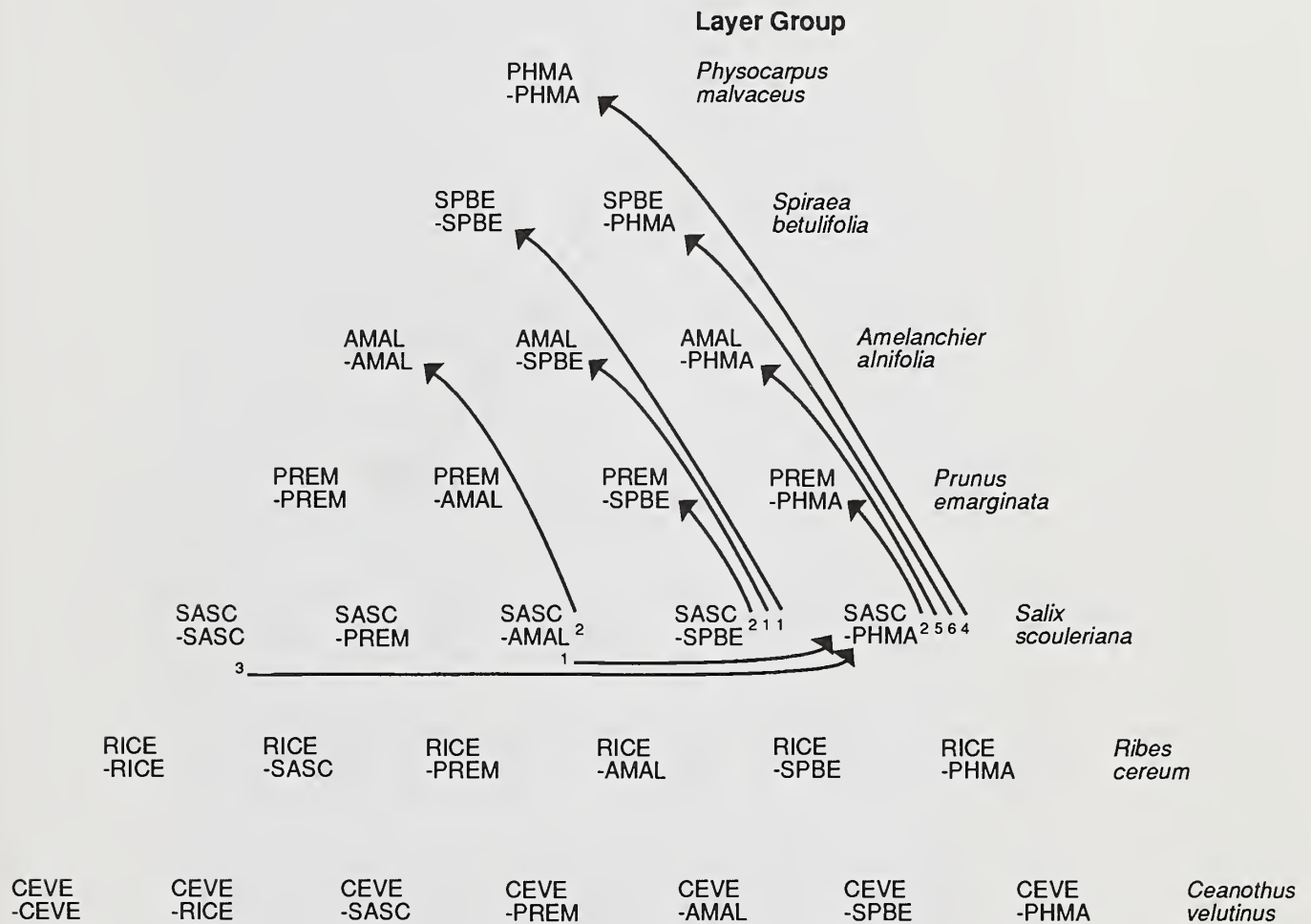
**APPENDIX B-2: SUCCESSIONAL DIRECTION OF SHRUB LAYER TYPES
IN THE CEVE LAYER GROUP AS INFERRED FROM INDIVIDUAL PLOT
DATA (NUMBERS INDICATE THE NUMBER OF PLOTS INVOLVED)**



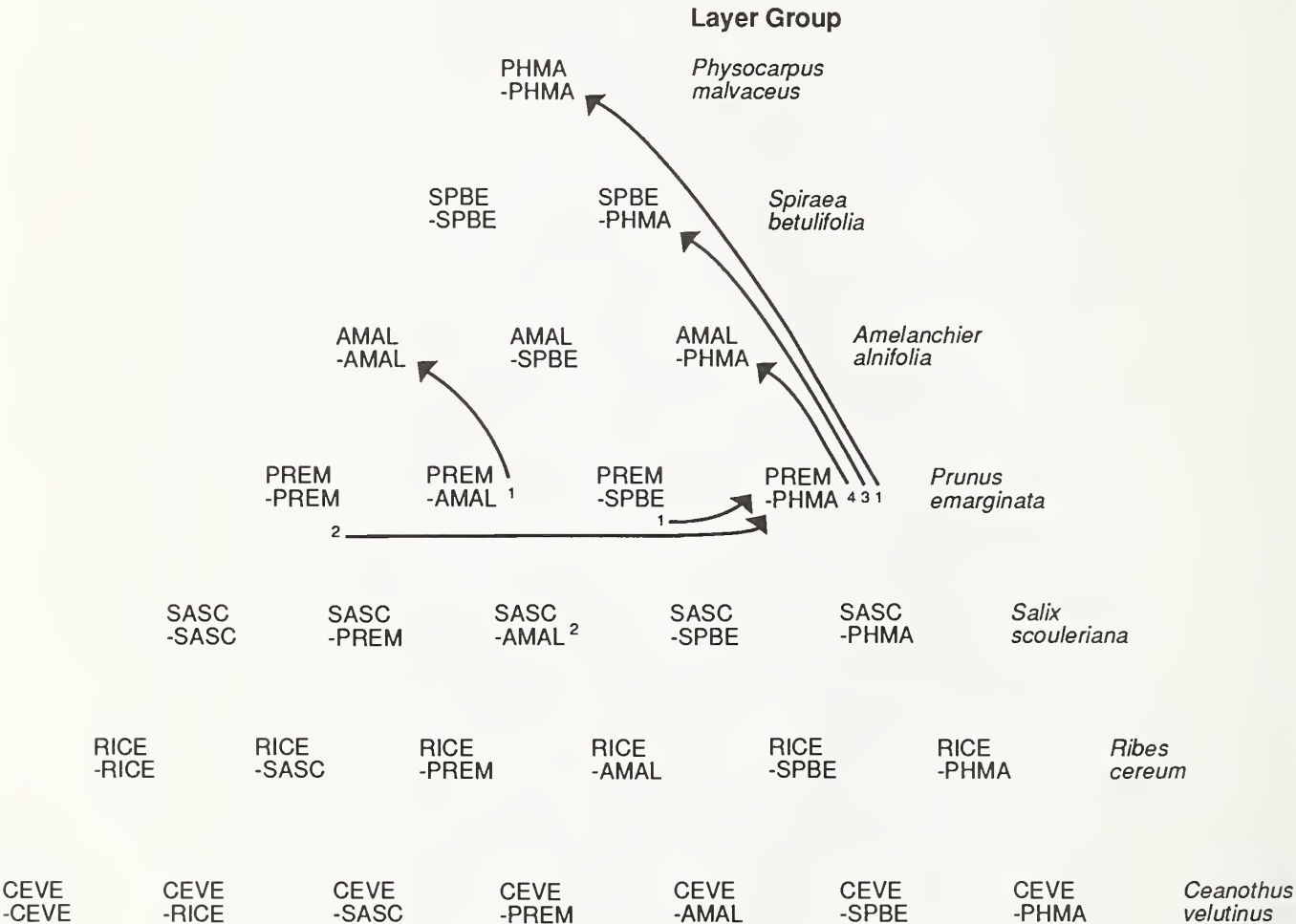
**APPENDIX B-3: SUCCESSIONAL DIRECTION OF SHRUB LAYER TYPES
IN THE RICE LAYER GROUP AS INFERRED FROM INDIVIDUAL PLOT
DATA (NUMBERS INDICATE THE NUMBER OF PLOTS INVOLVED)**



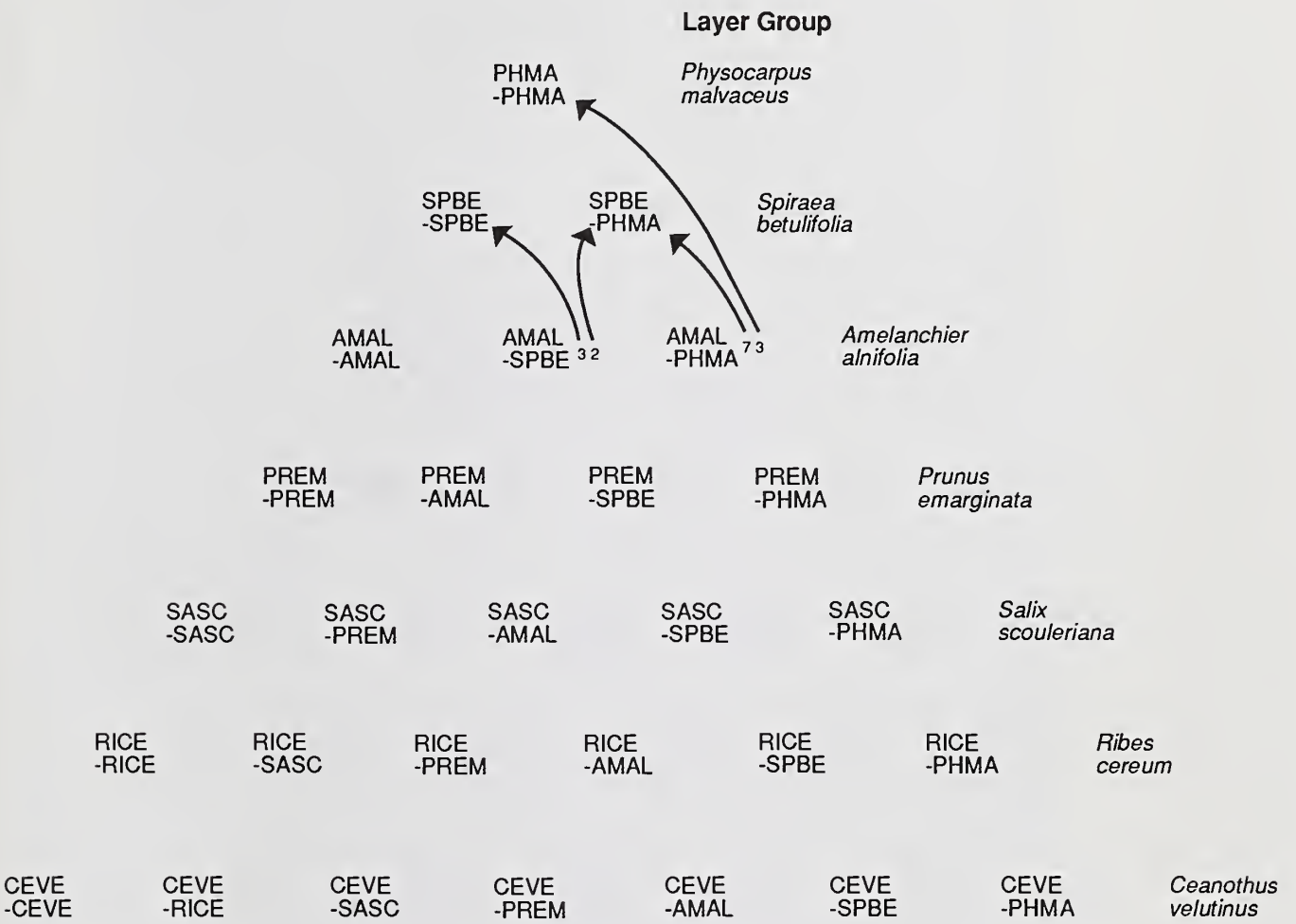
**APPENDIX B-4: SUCCESSIONAL DIRECTION OF SHRUB LAYER TYPES
IN THE SASC LAYER GROUP AS INFERRED FROM INDIVIDUAL PLOT
DATA (NUMBERS INDICATE THE NUMBER OF PLOTS INVOLVED)**



APPENDIX B-5: SUCCESSIONAL DIRECTION OF SHRUB LAYER TYPES IN THE PREM LAYER GROUP AS INFERRED FROM INDIVIDUAL PLOT DATA (NUMBERS INDICATE THE NUMBER OF PLOTS INVOLVED)

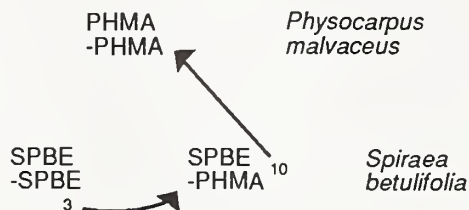


**APPENDIX B-6: SUCCESSIONAL DIRECTION OF SHRUB LAYER TYPES
IN THE AMAL LAYER GROUP AS INFERRED FROM INDIVIDUAL PLOT
DATA (NUMBERS INDICATE THE NUMBER OF PLOTS INVOLVED)**



APPENDIX B-7: SUCCESSIONAL DIRECTION OF SHRUB LAYER TYPES IN THE SPBE LAYER GROUP AS INFERRED FROM INDIVIDUAL PLOT DATA (NUMBERS INDICATE THE NUMBER OF PLOTS INVOLVED)

Layer Group



AMAL
-AMAL

AMAL
-SPBE

AMAL
-PHMA

*Amelanchier
alnifolia*

PREM
-PREM

PREM
-AMAL

PREM
-SPBE

PREM
-PHMA

*Prunus
emarginata*

SASC
-SASC

SASC
-PREM

SASC
-AMAL

SASC
-SPBE

SASC
-PHMA

*Salix
scouleriana*

RICE
-RICE

RICE
-SASC

RICE
-PREM

RICE
-AMAL

RICE
-SPBE

RICE
-PHMA

*Ribes
cereum*

CEVE
-CEVE

CEVE
-RICE

CEVE
-SASC

CEVE
-PREM

CEVE
-AMAL

CEVE
-SPBE

CEVE
-PHMA

*Ceanothus
velutinus*

APPENDIX C: PALATABILITY RATINGS, CONSTANCY,¹ AND AVERAGE CANOPY COVER (PERCENT) OF HERB LAYER SPECIES BY LAYER IN THE PSME/PHMA H.T., PIPO PHASE

HERB LAYER GROUP										Annuals				Bromus carinatus	
Herb layer type		ANN. -ANN.	ANN. -BRCA	ANN. -POGL	ANN. -ILRI	ANN. -CAGE	ANN. -CARU	BRCA -BRCA	BRCA -FRVE						
Number of stands		n = 3	n = 2	n = 2	n = 1	n = 1	n = 1	n = 3	n = 1						
Palatability ratings ²															
ADP No.	Perennial Graminoids	Deer		Elk		Cattle		Sheep		Black bear					
		Summer	Winter	Summer	Winter	Summer	Winter	Spring	Summer	Spring	Summer	Spring	Summer		
*18	Agropyron intermedium	0	0	0	0	0	0	0	0	0	0	0	0		
301	Agropyron spicatum	2	4	4	6	4	2	0	0	0	0	0	0		
303	Bromus carinatus	4	2	6	4	6	4	0	0	0	0	0	0		
282	Bromus inermis	4	0	4	0	6	5	0	0	0	0	0	0		
307	Calamagrostis rubescens	2	4	6	4	6	4	6	4	2	4	2	2		
309	Carex geyeri	4	4	6	6	6	4	4	4	2	4	2	2		
311	Carex rossii	2	2	4	2	2	4	4	4	2	4	2	2		
331	Poa nervosa	4	2	6	4	4	4	0	0	0	0	0	0		
Perennial Herbs															
401	Achillea millefolium	2	2	2	2	2	4	0	0	0	0	0	0		
566	Agastache urticifolia	4	0	4	0	4	6	0	0	0	0	0	0		
413	Antennaria racemosa	4	0	2	2	0	0	0	0	0	0	0	0		
415	Apocynum androsaemifolium	2	0	2	0	2	2	0	0	0	0	0	0		
420	Arenaria macrophylla	2	0	2	0	2	4	0	0	0	0	0	0		
421	Arnica cordifolia	4	0	4	0	0	2	4	4	0	0	0	0		
426	Aster conspicuus	2	2	4	2	4	4	0	0	0	0	0	0		
586	Aster perelegans	4	2	4	2	4	4	0	0	0	0	0	0		
431	Balsamorhiza sagittata	4	4	2	4	4	6	0	0	0	0	0	0		
736	Castilleja applegatei	2	0	2	0	2	2	0	0	0	0	0	0		
438	Castilleja miniata	2	0	2	0	2	2	0	0	0	0	0	0		
455	Disporum trachycarpum	0	0	0	0	0	0	0	0	0	0	0	0		
459	Epilobium angustifolium	4	2	6	2	2	4	0	0	0	0	0	0		
467	Fragaria spp.	4	4	2	4	2	4	2	6	2	6	2	2		
471	Galium triflorum	2	0	2	0	2	4	4	4	2	2	2	2		
473	Geranium viscosissimum	4	2	6	2	2	4	0	0	0	0	0	0		
628	Hackelia micrantha	0	0	0	0	0	0	0	0	0	0	0	0		
483	Hieracium albertinum	4	2	4	2	6	6	0	0	0	0	0	0		
484	Hieracium albiflorum	4	2	4	2	6	6	0	0	0	0	0	0		
633	Hydrophyllum capitatum	0	0	0	0	0	0	6	4	2	4	2	2		
833	Iliamna rivularis	4	0	6	0	4	6	0	0	0	0	0	0		
636	Lathyrus nevadensis	4	2	4	2	6	6	0	0	0	0	0	0		
505	Osmorhiza chilensis	2	0	2	0	2	4	6	4	2	4	2	2		
656	Paeonia brownii	2	0	2	0	2	2	0	0	0	0	0	0		

¹Code to constancy values: + = 0-5%, 1 = 5-15%, 2 = 15-25%, 3 = 25-35%, 4 = 35-45%, 5 = 45-55%, 6 = 55-65%, 7 = 65-75%, 8 = 75-85%, 9 = 85-95%, 10 = 95-100%
²Based on palatability ratings by Kufeld (1973), Kufeld and others (1973), USDA FS, (1986) and Beecham (1981).

APPENDIX C (Con.)¹

HERB LAYER GROUP										Annuals										Bromus carinatus			
Herb layer type		ANN. -ANN.		ANN. -BRCA		ANN. -POGL		ANN. -ILRI		ANN. -CAGE		ANN. -CARU		BRCA -BRCA		BRCA -FRVE							
Number of stands		n = 3		n = 2		n = 2		n = 1		n = 1		n = 1		n = 3		n = 1							
Palatability ratings ²		Deer				Elk				Black bear													
ADP Perennial		Summer		Winter		Summer		Winter		Cattle		Sheep		Spring		Summer		Fall					
No. herbs																							
658	<i>Penstemon attenuatus</i>	4	2	2	2	2	2	2	2	2	2	4	0	0	0	0	0	0	0				
514	<i>Penstemon wilcoxii</i>	4	2	2	2	2	2	2	2	2	2	4	0	0	0	0	0	0	0				
522	<i>Potentilla glandulosa</i>	4	2	2	2	2	2	2	2	2	2	4	0	0	0	0	0	0	0				
675	<i>Rudbeckia occidentalis</i>	4	2	2	2	2	2	2	2	2	2	4	0	0	0	0	0	0	0				
542	<i>Smilacina racemosa</i>	6	2	4	2	2	4	2	2	2	2	4	6	4	2	2	2	2	2				
685	<i>Stellaria jamesiana</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
#47	<i>Thalictrum</i> spp.	4	2	6	2	2	4	2	2	2	2	4	0	0	0	0	0	0	0				
*09	<i>Tragopogon dubius</i>	4	2	4	4	4	4	4	4	4	4	4	0	0	0	0	0	0	0				
560	<i>Trillium ovatum</i>	0	0	0	0	0	0	0	0	0	0	0	4	4	2	2	2	2	2				
691	<i>Veratrum californicum</i>	4	2	4	2	4	2	2	2	2	4	4	2	2	2	2	2	2	2				
Ferns																							
259	<i>Pteridium aquilinum</i>	4	0	2	0	0	0	2	4	0	0	0	0	0	0	0	0	0	0				
Annuals, biennials, and short-lived perennials																							
417	<i>Arabis</i> spp.	2	0	2	0	0	0	2	2	2	2	2	0	0	0	0	0	0	0				
*11	<i>Bromus tectorum</i>	2	4	2	4	2	2	2	2	2	2	2	0	0	0	0	0	0	0				
*12	<i>Cirsium vulgare</i>	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0	0	0				
912	<i>Clarkia rhomboidea</i>	2	0	2	0	0	0	2	2	2	2	2	0	0	0	0	0	0	0				
902	<i>Collinsia parviflora</i>	2	0	2	0	0	0	2	2	2	2	2	0	0	0	0	0	0	0				
913	<i>Collomia grandiflora</i>	2	0	2	0	0	0	2	2	2	2	2	0	0	0	0	0	0	0				
921	<i>Collomia tenella</i>	2	0	2	0	0	0	2	2	2	2	2	0	0	0	0	0	0	0				
#54	<i>Cryptantha</i> spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
915	<i>Descurainia richardsonii</i>	2	0	2	0	0	0	2	2	2	2	2	0	0	0	0	0	0	0				
904	<i>Epilobium</i> spp.	2	0	2	0	0	0	2	2	2	2	2	0	0	0	0	0	0	0				
#55	<i>Galium</i> spp.	2	0	2	0	0	0	2	2	2	2	2	6	4	2	2	2	2	2				
930	<i>Gayophytum</i> spp.	2	0	2	0	0	0	2	2	2	2	2	0	0	0	0	0	0	0				
886	<i>Gnaphalium microcephalum</i>	2	0	2	0	0	0	2	4	0	2	4	0	0	0	0	0	0	0				
*02	<i>Lactuca serriola</i>	4	2	4	2	2	4	2	6	6	6	6	0	0	0	0	0	0	0				
#51	<i>Phacelia</i> spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				
*16	<i>Verbascum thapsus</i>	2	2	2	2	2	2	2	2	2	2	2	0	0	0	0	0	0	0				
999	Bare soil																						
Years since disturbance - average:		6		12		6		6		2		17		11		6		13					
range:		4 - 10		8 - 15		3 - 9		-		-		-		-		5 - 7		-					

¹Code to constancy values: + = 0-5%, 1 = 5-15%, 2 = 15-25%, 3 = 25-35%, 4 = 35-45%, 5 = 45-55%, 6 = 55-65%, 7 = 65-75%, 8 = 75-85%, 9 = 85-95%, 10 = 95-100%
²Based on palatability ratings by Kufeld (1973), Kufeld and others (1973), USDA-FS (1986), and Beecham (1981).

(con.)

APPENDIX C (Con.)¹

HERB LAYER GROUP	Potentilla glandulosa			Iliamna rivularis	Epilobium angustifolium			Apocynum androsaemifolium		Fragaria vesca		Carex geyeri		Calamagrostis rubescens		Thalictrum occidentale	
Herb layer type	POGL -POGL	POGL -EPAN	POGL -FRVE	ILRI -ILRI	EPAN -EPAN	EPAN -APAN	EPAN -CARU	EPAN -THOC	APAN -APAN	APAN -CAGE	FRVE -CAGE	FRVE -CARU	CAGE -CAGE	CAGE -CARU	CARU -CARU	CARU -THOC	THOC -THOC
Number of stands	n = 5	n = 2	n = 1	n = 1	n = 3	n = 1	n = 2	n = 1	n = 2	n = 1	n = 1	n = 3	n = 21	n = 5	n = 25	n = 2	n = 10
ADP Perennial																	
No. graminoids																	
*18 Agropyron intermedium	—	—	—	—	3(3.0)	—	—	—	—	—	—	—	—	—	—	—	—
301 Agropyron spicatum	—	—	—	—	3(0.5)	—	—	—	—	10(3.0)	—	—	1(1.3)	—	—	—	—
303 Bromus carinatus	6(1.3)	10(0.5)	10(0.5)	—	—	—	—	—	5(0.5)	—	—	—	2(0.5)	2(0.5)	0(0.5)	5(3.0)	2(0.5)
282 Bromus inermis	—	—	—	—	3(0.5)	—	—	10(0.5)	—	—	10(0.5)	—	—	—	—	—	1(0.5)
307 Calamagrostis rubescens	4(0.5)	—	—	10(3.0)	7(3.0)	10(3.0)	10(7.8)	—	—	10(0.5)	10(15.0)	10(22.5)	4(3.6)	10(7.3)	8(21.5)	5(0.5)	5(0.5)
309 Carex geyeri	8(1.1)	5(3.0)	—	10(0.5)	3(0.5)	10(0.5)	10(1.8)	—	10(1.8)	10(15.0)	10(3.0)	7(0.5)	10(24.3)	10(12.1)	6(1.2)	—	6(0.9)
311 Carex rossii	4(0.5)	—	10(0.5)	10(0.5)	7(0.5)	—	5(0.5)	10(0.5)	—	—	10(0.5)	3(0.5)	2(0.5)	4(0.5)	1(0.5)	5(0.5)	1(0.5)
331 Poa nervosa	—	—	—	—	3(0.5)	—	—	—	—	—	—	3(3.0)	2(0.5)	—	1(0.5)	—	—
Perennial herbs																	
401 Achillea millefolium	6(0.5)	5(0.5)	10(0.5)	10(0.5)	—	—	—	—	5(0.5)	—	10(0.5)	10(0.5)	3(0.5)	2(0.5)	3(0.5)	—	—
566 Agastache urticifolia	4(15.0)	—	—	—	—	—	—	—	—	10(3.0)	—	—	0(0.5)	—	0(0.5)	—	1(0.5)
413 Antennaria racemosa	—	—	—	—	—	—	—	—	—	—	10(0.5)	—	0(0.5)	—	2(11.9)	—	—
415 Apocynum androsaemifolium	—	5(15.0)	10(0.5)	—	3(0.5)	10(3.0)	—	—	10(15.0)	—	—	3(0.5)	2(0.5)	—	2(1.1)	—	1(0.5)
420 Arenaria macrophylla	4(0.5)	5(0.5)	—	—	—	10(0.5)	5(0.5)	—	—	—	10(0.5)	3(0.5)	8(0.8)	10(0.5)	7(1.1)	—	5(1.0)
421 Arnica cordifolia	4(1.8)	—	—	10(0.5)	7(1.8)	—	10(9.0)	—	—	—	10(0.5)	3(62.5)	7(2.5)	10(9.2)	8(10.6)	10(15.0)	2(1.8)
426 Aster conspicuus	2(0.5)	5(15.0)	10(0.5)	—	3(3.0)	—	—	10(0.5)	—	—	10(15.0)	7(0.5)	3(2.6)	2(15.0)	6(1.3)	—	6(0.9)
586 Aster perelegans	2(0.5)	—	—	—	3(0.5)	—	—	—	5(0.5)	—	—	—	1(1.3)	—	1(0.5)	—	—
431 Balsamorhiza sagittata	4(0.5)	—	—	10(0.5)	7(7.8)	—	—	—	5(3.0)	10(3.0)	—	—	4(0.5)	2(0.5)	0(0.5)	—	1(0.5)
736 Castilleja applegatei	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1(0.5)	—	—
438 Castilleja miniata	—	—	—	—	—	—	10(7.8)	10(3.0)	—	—	10(0.5)	3(0.5)	2(0.5)	—	2(1.1)	—	—
455 Disporum trachycarpum	—	—	—	—	—	—	—	—	—	—	—	—	1(0.5)	—	2(1.0)	—	1(0.5)
459 Epilobium angustifolium	2(0.5)	5(0.5)	—	—	3(15.0)	10(15.0)	5(15.0)	10(15.0)	—	—	—	—	2(0.5)	2(0.5)	4(0.5)	10(0.5)	8(0.8)
467 Fragaria spp.	—	—	10(62.5)	—	3(3.0)	10(3.0)	5(0.5)	10(0.5)	5(0.5)	—	10(15.0)	10(22.5)	4(1.1)	8(1.1)	5(1.3)	—	3(0.5)
471 Galium triflorum	—	—	—	—	—	—	5(0.5)	—	—	—	—	—	—	—	3(2.6)	10(1.8)	4(0.5)
473 Geranium viscosissimum	4(1.8)	10(7.8)	—	—	3(15.0)	10(0.5)	—	10(0.5)	5(0.5)	10(0.5)	10(3.0)	3(0.5)	2(0.5)	—	1(0.5)	—	1(0.5)
628 Hackelia micrantha	6(1.3)	—	—	—	—	—	—	—	—	10(0.5)	—	—	—	—	—	—	1(0.5)
483 Hieracium albertinum	—	—	—	—	3(3.0)	—	—	—	—	—	—	—	4(0.5)	2(0.5)	2(0.5)	—	2(0.5)
484 Hieracium albiflorum	2(0.5)	—	—	—	—	10(0.5)	5(0.5)	—	—	—	10(0.5)	3(0.5)	2(0.5)	6(0.5)	4(0.5)	5(0.5)	2(0.5)
633 Hydrophyllum capitatum	6(0.5)	5(0.5)	—	—	—	—	—	—	5(0.5)	10(0.5)	—	—	0(0.5)	4(0.5)	1(0.5)	—	1(3.0)
833 Iliamna rivularis	2(0.5)	—	10(0.5)	10(15.0)	3(0.5)	10(0.5)	—	—	—	—	—	—	0(3.0)	—	—	—	—
636 Lathyrus nevadensis	2(0.5)	—	—	—	—	—	—	—	5(3.0)	—	—	3(0.5)	0(3.0)	2(0.5)	1(6.2)	—	1(15.0)
605 Osmorhiza chilensis	—	—	—	—	3(0.5)	—	—	—	5(0.5)	—	—	3(0.5)	0(0.5)	4(1.8)	3(0.5)	5(0.5)	4(0.5)
656 Paeonia brownii	4(0.5)	5(0.5)	—	—	—	—	—	—	—	—	—	—	0(0.5)	4(0.5)	1(0.5)	—	1(0.5)

¹Code to constancy values: + = 0-5% 1 = 5-15% 2 = 15-25% 3 = 25-35% 4 = 35-45% 5 = 45-55% 6 = 55-65% 7 = 65-75% 8 = 75-85% 9 = 85-95% 10 = 95-100%

(con.)

APPENDIX C (Con.)¹

HERB LAYER GROUP		<i>Potentilla glandulosa</i>		<i>Iliamna rivularis</i>		<i>Epilobium angustifolium</i>			<i>Apocynum androsaemifolium</i>		<i>Fragaria vesca</i>		<i>Carex geyerl</i>		<i>Calamagrostis rubescens</i>		<i>Thalictrum occidentale</i>
Herb layer type		POGL -POGL	POGL -EPAN	POGL -FRVE	ILRI -ILRI	EPAN -EPAN	EPAN -CARU	EPAN -THOC	APAN -APAN	APAN -CAGE	FRVE -FRVE	FRVE -CARU	CAGE -CAGE	CAGE -CARU	CARU -CARU	CARU -THOC	THOC -THOC
Number of stands		n = 5	n = 2	n = 1	n = 1	n = 1	n = 2	n = 1	n = 2	n = 1	n = 1	n = 3	n = 21	n = 5	n = 25	n = 2	n = 10
ADP Perennial																	
No. herbs																	
658 <i>Penstemon attenuatus</i>		—	5(15.0)	—	10(0.5)	—	—	—	—	—	—	—	1(0.5)	—	0(0.5)	—	—
514 <i>Penstemon wilcoxii</i>		6(0.5)	5(0.5)	10(3.0)	—	7(0.5)	—	—	—	—	10(0.5)	7(0.5)	4(0.5)	6(0.5)	3(0.5)	5(0.5)	6(0.5)
522 <i>Potentilla glandulosa</i>		10(17.1)	10(15.0)	10(0.5)	—	3(0.5)	5(0.5)	10(0.5)	5(0.5)	10(0.5)	10(0.5)	3(0.5)	5(0.5)	—	1(1.3)	—	4(0.5)
675 <i>Rudbeckia occidentalis</i>		2(0.5)	—	10(37.5)	—	—	—	—	—	—	—	—	—	—	—	—	—
542 <i>Smilacina racemosa</i>		6(0.5)	5(0.5)	—	—	—	10(0.5)	—	—	—	—	7(0.5)	7(0.5)	8(0.5)	5(1.1)	10(0.5)	6(0.9)
685 <i>Stellaria jamesiana</i>		—	—	—	—	—	—	—	—	—	—	—	2(0.5)	2(0.5)	0(0.5)	—	2(0.5)
#47 <i>Thalictrum</i> spp.		6(0.5)	5(0.5)	—	—	—	10(3.0)	10(15.0)	—	—	10(0.5)	3(3.0)	3(0.5)	6(1.3)	4(2.7)	10(15.0)	9(17.5)
*09 <i>Tragopogon dubius</i>		—	—	—	—	7(0.5)	—	—	—	—	10(0.5)	—	1(0.5)	—	1(0.5)	—	1(0.5)
560 <i>Trillium ovatum</i>		—	—	—	—	—	—	—	—	—	—	3(3.0)	—	—	2(0.5)	5(0.5)	1(0.5)
691 <i>Veratrum californicum</i>		2(3.0)	5(0.5)	—	—	—	—	—	—	10(15.0)	—	3(0.5)	—	4(0.5)	1(0.5)	5(0.5)	3(0.5)
Ferns																	
259 <i>Pteridium aquilinum</i>		—	—	—	—	10(15.0)	—	—	—	—	—	—	0(0.5)	2(0.5)	1(3.0)	5(0.5)	1(0.5)
Annuals, biennials, and short-lived perennials																	
417 <i>Arabis</i> spp.		6(0.5)	—	—	—	3(0.5)	—	10(0.5)	5(0.5)	10(0.5)	—	—	1(0.5)	—	0(0.5)	—	—
*11 <i>Bromus tectorum</i>		—	—	—	—	—	—	—	5(0.5)	—	—	—	0(0.5)	—	0(0.5)	—	—
*12 <i>Cirsium vulgare</i>		—	—	10(0.5)	—	—	—	—	—	—	—	—	—	—	0(0.5)	—	—
912 <i>Clarkia rhomboidea</i>		2(0.5)	—	—	—	3(0.5)	—	—	—	—	—	—	1(0.5)	—	2(0.5)	—	—
902 <i>Collinsia parviflora</i>		8(2.4)	—	—	—	—	—	—	—	10(0.5)	—	—	1(0.5)	2(0.5)	2(0.5)	—	—
913 <i>Collomia grandiflora</i>		—	5(0.5)	—	—	—	—	—	—	—	—	—	1(0.5)	—	1(1.3)	—	—
921 <i>Collomia tenella</i>		—	—	—	—	10(0.5)	—	—	5(0.5)	—	—	—	1(0.5)	—	0(0.5)	—	—
#54 <i>Cryptantha</i> spp.		4(0.5)	—	—	—	3(0.5)	—	—	—	—	—	—	1(0.5)	—	0(0.5)	—	1(0.5)
915 <i>Descurainia richardsonii</i>		2(0.5)	—	10(0.5)	—	—	—	—	—	—	—	—	—	—	—	—	—
904 <i>Epilobium</i> spp.		—	5(0.5)	10(0.5)	—	3(0.5)	—	—	—	—	—	—	1(0.5)	—	1(0.5)	—	—
#55 <i>Galium</i> spp.		8(1.1)	—	—	—	—	—	—	—	—	—	—	1(0.5)	—	2(1.1)	—	—
930 <i>Gayophytum</i> spp.		2(0.5)	5(3.0)	10(0.5)	—	7(3.0)	10(0.5)	—	—	—	—	—	—	—	—	—	1(0.5)
886 <i>Gnaphalium microcephalum</i>		—	—	—	—	7(0.5)	—	—	5(0.5)	—	—	—	0(0.5)	—	—	—	—
*02 <i>Lactuca serriola</i>		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
#51 <i>Phacelia</i> spp.		6(0.5)	—	—	—	10(0.5)	—	10(0.5)	5(0.5)	—	—	—	1(0.5)	—	—	—	1(0.5)
*16 <i>Verbascum thapsus</i>		—	—	10(0.5)	—	—	—	—	—	—	—	—	0(0.5)	—	—	—	—
999 Bare soil		10(17.1)	10(26.3)	10(15.0)	10(62.5)	10(15.0)	5(15.0)	10(3.0)	10(7.8)	10(15.0)	10(3.0)	7(3.0)	6(4.8)	2(0.5)	3(17.1)	10(0.5)	1(3.0)
Years since disturbance - average:	8	13	9	5	17	15	34	8	18	50	10	19	52	54	66	25	60
- range:	5 - 13	8 - 18	—	—	6 - 37	—	13 - 55	—	—	—	—	10 - 18	8 - 125	8 - 100	10 - 146	10 - 40	4 - 100

¹Code to constancy values: + = 0-5% 1 = 5-15% 2 = 15-25% 3 = 25-35% 4 = 35-45% 5 = 45-55% 6 = 55-65% 7 = 65-75% 8 = 75-85% 9 = 85-95% 10 = 95-100%

APPENDIX D: SUCCESSION CLASSIFICATION FIELD FORM FOR THE DOUGLAS-FIR/NINEBARK H.T.

(Code Descriptions)					Name:	
Livestock Effects: 1-Light Cattle Use (palatable species stable) 2-Heavy Cattle Use (palatable species declining) 3-Light Sheep Use 4-Heavy Sheep Use 5-Trampling (soil surface exposed) 6-None 7-Other—					Plot No.: Location: Date: Livestock effects: Fire effects: -Age Scarification effects: -Age	
Fire Effects: 1-Stand Destroyed 2-Stand Partially Destroyed 3-Creeping Ground Fire 4-Hot Broadcast Burn (soil exposed by fire) 5-Cool Broadcast Burn (soil not exposed) 6-Burned Slash Piles 7-None 8-Other—						
Scarification Effects: 1-Heavy (soil well churned) 2-Light (only duff removed) 3-Soil Scraped Away (by dozer blade) 4-Soil in Piles >18" (from dozer) 5-None 6-Other—					Vegetation Coverage Class: 0-None 3-25 to 50% T-Rare to 1% 4-50 to 75% 1-1 to 5% 5-75 to 95% 2-5 to 25% 6-95 to 100%	
TREES - canopy coverage Rate coverage by d.b.h. classes: o.g. / m. / p. / s. >18" / 18-12" / 12-4" / 4-1"					PERENNIAL HERBS and FERNS	
ADP 001 <i>Abies grandis</i> — / — / — / — 002 <i>Abies lasiocarpa</i> — / — / — / — 010 <i>Pinus contorta</i> — / — / — / — 013 <i>Pinus ponderosa</i> — / — / — / — 014 <i>Populus tremuloides</i> — / — / — / — 016 <i>Pseudotsuga menziesii</i> — / — / — / —					566 <i>Agastache urticifolia</i> — — — — 415 <i>Apocynum androsaemifolium</i> — — — — 421 <i>Arnica cordifolia</i> — — — — 426 <i>Aster conspicuus</i> — — — — 421 <i>Balsamorhiza sagittata</i> — — — — #15 <i>Castilleja</i> spp. — — — — 459 <i>Epilobium angustifolium</i> — — — — 465 <i>Fragaria vesca</i> — — — — 466 <i>Fragaria virginiana</i> — — — — 470 <i>Galium triflorum</i> — — — — 473 <i>Geranium viscosissimum</i> — — — — 833 <i>Iliamna rivularis</i> — — — — 636 <i>Lathyrus nevadensis</i> — — — — 499 <i>Lupinus</i> spp. — — — — 658 <i>Penstemon attenuatus</i> — — — — 514 <i>Penstemon wilcoxii</i> — — — — 522 <i>Potentilla glandulosa</i> — — — — 529 <i>Pteridium aquilinum</i> — — — — 547 <i>Thalictrum occidentale</i> — — — — 691 <i>Veratrum californicum</i> — — — —	
SHRUBS - canopy coverage ADP 102 <i>Acer glabrum</i> — — — — — — — — 105 <i>Amelanchier alnifolia</i> — — — — — — — — 107 <i>Ceanothus velutinus</i> — — — — — — — — 198 <i>Ceanothus sanguineus</i> — — — — — — — — 119 <i>Philadelphus lewisii</i> — — — — — — — — 122 <i>Physocarpus malvaceus</i> — — — — — — — — 123 <i>Prunus emarginata</i> — — — — — — — — 124 <i>Prunus virginiana</i> — — — — — — — — 128 <i>Ribes cereum</i> — — — — — — — — 131 <i>Ribes viscosissimum</i> — — — — — — — — 136 <i>Rubus parviflorus</i> — — — — — — — — 137 <i>Salix scouleriana</i> — — — — — — — — 142 <i>Spiraea</i> sp. — — — — — — — — 143 <i>Symphoricarpos albus</i> — — — — — — — — 163 <i>Symphoricarpos oreophilus</i> — — — — — — — — 146 <i>Vaccinium globulare</i> — — — — — — — —					ANNUALS, BIENNIALS, and SHORT-LIVED PERENNIALS ADP *11 <i>Bromus tectorum</i> — — — — — *12 <i>Cirsium vulgare</i> — — — — — #56 <i>Collomia</i> spp. — — — — — 914 <i>Cryptantha</i> spp. — — — — — 915 <i>Descurainia</i> spp. — — — — — 904 <i>Epilobium</i> spp. — — — — — *55 <i>Galium</i> spp. — — — — — 930 <i>Gayophytum</i> spp. — — — — — 886 <i>Gnaphalium</i> spp. — — — — — *02 <i>Lactuca serriola</i> — — — — — 663 <i>Phacelia hastata</i> — — — — — 911 <i>Polygonum douglasii</i> — — — — — *16 <i>Verbascum thapsus</i> — — — — — 999 Bare soil — — — — —	
PERENNIAL GRAMINIDS ADP 301 <i>Agropyron spicatum</i> — — — — — — — — 303 <i>Bromus carinatus</i> — — — — — — — — 282 <i>Bromus inermis</i> — — — — — — — — 307 <i>Calamagrostis rubescens</i> — — — — — — — — 309 <i>Carex geyeri</i> — — — — — — — — 311 <i>Carex rossii</i> — — — — — — — — 331 <i>Poa nervosa</i> — — — — — — — —						
TREE LAYER TYPE SHRUB LAYER TYPE HERB LAYER TYPE						

Steele, Robert; Geier-Hayes, Kathleen. 1989. The Douglas-fir/ninebark habitat type in central Idaho: succession and management. Gen. Tech. Rep. INT-252. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 65 p.

Presents a taxonomic system for classifying plant succession in the Douglas-fir/ninebark habitat type in central Idaho. A total of six potential tree layer types, 28 shrub layer types, and 55 herbaceous layer types are categorized. Diagnostic keys based on indicator species provide for field identification of the types. Discussion of management implications includes pocket gopher populations, success of planted and natural tree seedlings, big-game and livestock forage preferences, and responses of major shrub and herb layer species to disturbance.

KEYWORDS: forest succession, plant communities, forest ecology, forest management, silviculture, classification, Idaho

Succession classification diagram of the shrub layer in the PSME/PHMA h.I.

*Physocarpus
malvaceus*

*Spiraea
betulifolia*

A metacharakter
abstrakt

Prunella
maritima.

*Salix
scouleriana*

Ceanothus velutinus

American Museum of Natural History
200 2nd Street
Origen UT 84401

Ceanothus velutinus* × *Ribes cereum
 D. × CEN. INT. has the same color as the C. and is broad-ovate and thoroughly serrate. It is a cross between the C. and R. but its germ is from seed sown in the soil and are equally as vigorous and its parents.

Cronothus velutinus* - *Salix scoulerianum

A clearcut and broadleaf forest area had been about 20 years ago. Cronothus has been burned and Salix from a seedling or seed, established in response to this disturbance. There is no evidence that the area is a forest. Pseudotsuga has established naturally on the ground in this aspect.

Ceanothus velutinus - Prunus emarginata

The CEANOTHUS is very type rich - the same 20-year-old ceanothus as the CEANOTHUS are type shown here but on a stem or more support. This is a specimen for dry for study to establish the lasted Prunus emarginata. a 0.00 say present before the disturbance has increased a change and now dominates the world of type.

Ceanothus velutinus - Amelanchier alnifolia

A = 1 plant only. Ceanothus velutinus is a small tree or shrub, 1-2 m tall, with white flowers. The leaves are dark green, glossy, and have a waxy texture. The fruit is a small, round, blue berry. Amelanchier alnifolia is a small tree or shrub, 1-2 m tall, with white flowers. The leaves are dark green, glossy, and have a waxy texture. The fruit is a small, round, blue berry.

Common name: Blueberry

Scientific name: Ceanothus velutinus

Family: Ericaceae

Native range: North America

Uses: Ornamental, fruit for food

Ceanothus velutinus - *Spiraea betulifolia*

Ceanothus velutinus - *Phytocarpus mulbaceus*

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